EDISON ELECTRIC INSTITUTE BULLETIN

AUGUST, 1942

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EDISON ELECTRIC INSTITUTE

THE ELECTRIC LIGHT AND POWER INDUSTRY

Current Statistical Data Covering 100 Per Cent of Industry

May, 1942

SOURCE AND DISPOSAL OF ENERGY—MONTH OF MAY

	1942	1941	%
GENERATION* (Net)			
By Fuel Burning Plants	9,630,152,000	9,367,900,000	+ 2.8
By Water Power Plants	5,358,243,000	4,243,700,000	+26.3
Total Generation	**14,988,395,000**	**13,611,600,000**	**+10.1**
Add—Net Imports Over International Boundaries	(Details	78,332,000	.....
Less—Company Use	Not	186,251,000	.....
Less—Energy Used by Producer	Yet	286,719,000	.....
Net Energy for Distribution	Available)	13,216,962,000	.....
Losses and Unaccounted For		2,091,210,000	.....
Sales to Ultimate Customers	**12,487,276,000**	**11,125,752,000**	**+12.2**

CLASSIFICATION OF SALES

NUMBER OF CUSTOMERS—As of May 31st			
Residential or Domestic	26,286,067	25,322,627	+ 3.8
Rural (Distinct Rural Rates)	1,092,267	939,688	.....
Commercial or Industrial:			
Small Light and Power	4,307,881	4,267,922	+ 0.4
Large Light and Power	148,961	171,437	
Other Customers	121,157	117,771	.....
Total Ultimate Customers	**31,956,333**	**30,819,445**	**+ 3.7**
KILOWATTHOUR SALES—During Month of May			
Residential or Domestic	2,047,312,000	1,903,451,000	+ 7.6
Rural (Distinct Rural Rates)	215,658,000	154,775,000	+39.3
Commercial or Industrial:			
Small Light and Power	2,123,795,000	1,911,964,000	+ 6.0*
Large Light and Power	7,073,649,000	6,234,198,000	+15.2*
Street and Highway Lighting	143,439,000	146,183,000	− 1.9
Other Public Authorities	293,739,000	243,007,000	+20.9
Railways and Railroads:			
Street and Interurban Railways	332,944,000	313,506,000	+ 6.2
Electrified Steam Railroads	187,545,000	168,178,000	+11.5
Interdepartmental	69,195,000	50,490,000	+37.0
Total to Ultimate Customers	**12,487,276,000**	**11,125,752,000**	**+12.2**
Revenue from Ultimate Customers	**$225,601,800**	**$210,134,100**	**+ 7.4**

** Based on Changes Made in Same Classifications Both Years

RESIDENTIAL OR DOMESTIC SERVICE (Revised Series)

AVERAGE CUSTOMER DATA—For the 12 Months Ended May 31st			
Kilowatthours per Customer	1,008	967	+ 4.2
Average Annual Bill	$37.30	$36.65	+ 1.8
Revenue per Kilowatthour	3.70¢	3.79¢	− 2.4

* By Courtesy of the Federal Power Commission

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EDISON ELECTRIC INSTITUTE BULLETIN

Volume 10 AUGUST, 1942 No. 8

Effect on Electric Utility Companies of New Federal Tax Provisions—Suggested Remedies

A Statement by C. W. Kellogg, President, Edison Electric Institute, submitted to the Finance Committee, United States Senate, Aug. 12, 1942

The purpose of this statement is:

(1) To show in a factual way the effect on electric utility companies of the new Federal tax provisions contained in H. R. 7378 now before the Senate Finance Committee;

(2) To indicate the considerations arising from the inherent nature of the utility industry which call for special treatment in this tax bill;

(3) To show the need to make provision for deferred maintenance to be performed during the post-war readjustment period; and

(4) To suggest remedies.

The electric utilities recognize that the present revenue needs of the Federal Government, on account of the war emergency, require heavy taxes on all elements of the nation, consistent with maintaining the ability of each to continue to function adequately and to be able in the future to continue heavy tax payments.

The tax proposals now before the Senate Finance Committee would seriously impair the credit of utility companies and adversely affect their ability to perform their essential public and war service. It is believed that these injurious effects of the bill can be corrected without loss of revenue to the Treasury.

1. Effect of Taxes on Utilities

The effect of taxes on electric utilities is shown in Tables 1, 2 and 3 (on next page), which compare actual financial results for the years 1940 and 1941 and estimated results for 1942, the latter based upon actual results for the first six months of the year after applying the Federal tax rates provided in H.R. 7378.

Due almost entirely to bigger Federal taxes, the net income of electric utilities for 1941 decreased 3 1/3 per cent below their 1940 net income, and in 1942 it is estimated there will be a further decrease of net income of 19 per cent below 1941. This 19 per cent decrease is an average figure for the industry; the effect on many individual corporations will be more serious. It will force the cutting or omission of many dividends, including some preferred dividends. It already has caused a tremendous decrease in the market value of utility stocks. The credit of the utilities is hurt and financing for expansion is jeopardized.

2. Considerations Calling for Special Treatment

Function of Utility Business. The real function of the utilities is to furnish the public with an essential service as cheaply as possible. This function is recognized by the Federal Government with respect to municipal and governmental electric systems, in their being exempted from *all* Federal taxes. In justice, all consumers of electricity should be treated alike by the Federal Government, and the electric utilities should therefore have the same exemption from Federal taxes as is enjoyed by governmental power enterprises. In no event, however, should the electric utility companies be taxed to such an amount that their ability to perform effectively in the war effort is impaired.

Large Investment in Fixed Plant. Essentially the electric utility business is one of a relatively large investment in fixed plant, the inducement to invest in which arises from the relatively stable nature of the business and from the regulation of the business by governmental bodies on a basis which allows a return on the investment at a rate sufficient to attract new capital to the business.

The electric utility business requires about eight times as much fixed investment per dollar of annual sales as does the average industrial enterprise. From this inherent condition it follows, first, that with utilities fixed charges comprise nearly 70 per cent of the total cost of doing business and, second, that with constant requirements for growth and expansion, the raising of new capital in large amounts is a continual necessity of the business in order to furnish adequate service. Thus, a given per cent decrease in net income is much more destructive to utilities than the same per cent decrease would be to the average industry. The maintenance of the credit of utility companies is absolutely essential for the proper carrying out of their service obligations.

Regulated Rates. Unlike other enterprises, utilities are unable to raise the price of their products or recoup themselves from higher costs. Their rates are strictly regulated. As a matter of fact, they have steadily reduced the average charges for their services. Appended hereto are two charts, (1) comparing the average unit price of electricity in the home with the cost of living for the last thirty years and (2) comparing the average unit price of wholesale electricity with all other wholesale prices and with their own unit payroll costs for the same period. The conclusion follows that there is ample basis for placing an industry, which, like utilities, has such characteristics, in a special class from the standpoint of taxation.

Effect on Utility Credit. The very large fixed investment of about $13,000,000,000 in the electric utility business is represented about one-half by bonds and one-half by stocks, preferred and common. The bonds could not have been sold without the margin of security represented by the stock investment; and the stocks could not have been sold without the expectation of reasonable divi-

TABLE 1—INCOME STATEMENT, ELECTRIC UTILITY COMPANIES
(Millions of Dollars)

	1940	1941	Per Cent Change	1942*	% Change from 1941
Operating Revenues	$2,277	$2,475	+ 9	$2,650	+ 7
Operating Expenses	863	955	+ 11	1,050	+ 10
Depreciation	260	279	+ 7	300	+ 7½
Taxes	404	511	+ 26	658	+ 29
Total Deductions	1,527	1,745	+ 14	2,008	+ 15
Operating Income	750	730	− 3	642	− 12
Income Other Departments	62	55	− 11	50	− 9
Non-Operating Income	77	74	− 4	55	− 25
Gross Corporate Income	889	859	− 3	747	− 13
Interest and Amortization	315	303	− 4	293	− 3
Other Deductions	17	17		17	
Net Income	557	539	− 3	437	− 19

(Source: 1940/41 as shown in Edison Electric Institute Statistical Bulletin No. 9, Table 33, page 39.)

* Estimated on basis of actual results for first six months of 1942 with Federal Tax Rates of House Bill (H. R. 7378) applied.

Table 1 shows that notwithstanding an increase in gross revenue of $198,000,000 in 1941, net income, due largely to taxes, dropped $18,000,000 or 3.3 per cent. The big expansion in electricity sales took place principally in the lower priced industrial use of electricity rather than in the higher priced retail sales. This shift is becoming more pronounced in 1942 and has further slowed down the percentage increase in gross revenue.

Only about 35 per cent of operating revenues represent costs which vary with the volume of output; all the balance are fixed charges of one form or another. With general manufacturing industry these ratios are approximately reversed—about 65 per cent of their total costs vary with volume of output.

TABLE 2—BREAKDOWN OF UTILITY TAXES*
(Millions of Dollars)

	1940	1941	Increase	1942(a)	Increase over 1941
Federal Taxes:					
Income Taxes	$129	$180	$ 51	$250	$ 70
Excess Profits	6	45	39	110	65
3½ Excise Tax	44	49	5	53	4
All Other Federal	11	20	9	25	5
Total Federal	190	294	104	438	144
State and Local Taxes	214	217	3	220	3
Total Taxes	404	511	107	658	147

* Preliminary figures; based upon reports covering 70% of total revenues.
(a) Estimate, based on actual results for first six months of 1942 and application of Federal Tax Rates contained in H. R. 7378.

TABLE 3—GROWTH OF ELECTRIC UTILITY TAX BURDEN
Per Cent of Gross Revenue

Year	Spent for Operating, Maintenance and Depreciation	Spent for Taxes	Balance Available for Return on Investment and Extensions	Total
1930	46	10	44	: 100
1935	48	14	38	: 100
1940	49	18	33	: 100
1941	50	20	30	: 100
1942*	51	25	24	: 100

* Estimate, based on actual results for the first six months.

Table 3 shows that the relative tax burden has doubled since 1930 and in 1942, based on proposed tax bill, will be 2½ times as great. It shows also, by the rise in the proportional amount required for operation and maintenance, that it has not been possible to offset the increased cost of labor and materials by economies and by the expansion of sales of electricity. It shows further that the increase in the tax burden has combined with this factor to reduce sharply the return on the investment, which in 1941 was one-third less than it was even in the depression year of 1930 and in 1942 bids fair to be only about half as large.

The trend of electricity prices in the past thirty years is shown on the accompanying charts. These emphasize why utilities cannot meet big increases in taxes from increased gross revenue.

TABLE 4—EFFECT OF FEDERAL INCOME AND EXCISE PROFITS TAXES UPON EARNINGS OF ELECTRIC LIGHT AND POWER COMPANIES IN THE UNITED STATES

Year	Net Income Before Federal Income & Excess Profits Taxes (million $)	Federal Income and Excess Profits Taxes (million $) Income	Excess Profits	Total	% Before Taxes	Net Income After All Taxes & Charges (million $)
1917(a)	122	..	..	6	5%	116
1922(b)	240	..	..	10	4%	230
1927	508	36	..	36	7%	472
1932	542	36	..	36	7%	506
1933	437	33	..	33	8%	404
1934	435	44	..	44	10%	391
1935	459	39	..	39	9%	420
1936	512	52	..	52	10%	460
1937	575	66	..	66	12%	509
1938	548	63	..	63	12%	485
1939	628	89	..	89	14%	539
1940	692	129	6	135	20%	557
1941	764	180	45	225	30%	539
1942(note c)	797	250	110	360	45%	437

Years 1922-1938 inclusive are actual collections as reported by Bureau of Internal Revenue. Years 1917 and 1939 to 1942 are as carried on utility books and may vary somewhat from actual collections.

* All privately owned utilities, including multiple-service companies which supply gas, water, traction and other services in addition to electricity.
(a) Based upon U. S. Census of Central Stations for 1917, which represented 78% of the electric light and power companies as now constituted.
(b) Based upon U. S. Census of Central Stations for 1922, which represented 87% of the electric light and power companies as now constituted.
(c) Estimated on basis of first half year and applying rates of Federal Taxation as enacted by House of Representatives.

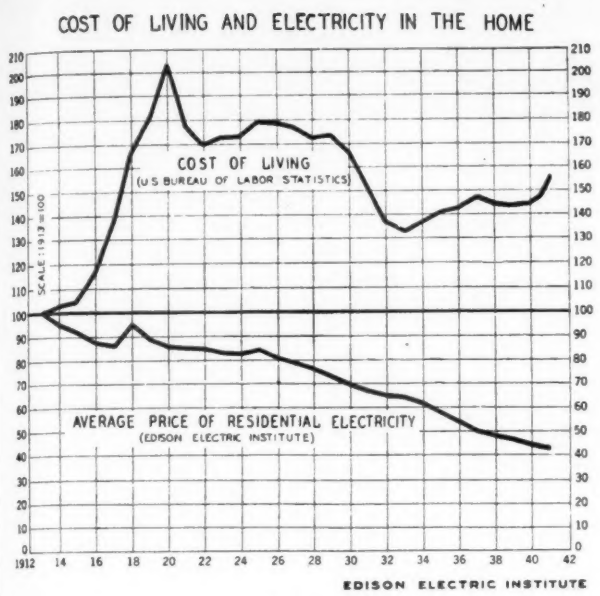
COST OF LIVING AND ELECTRICITY IN THE HOME
COST OF LIVING
(U.S BUREAU OF LABOR STATISTICS)
SCALE: 1913 = 100
AVERAGE PRICE OF RESIDENTIAL ELECTRICITY
(EDISON ELECTRIC INSTITUTE)
EDISON ELECTRIC INSTITUTE

Chart 1

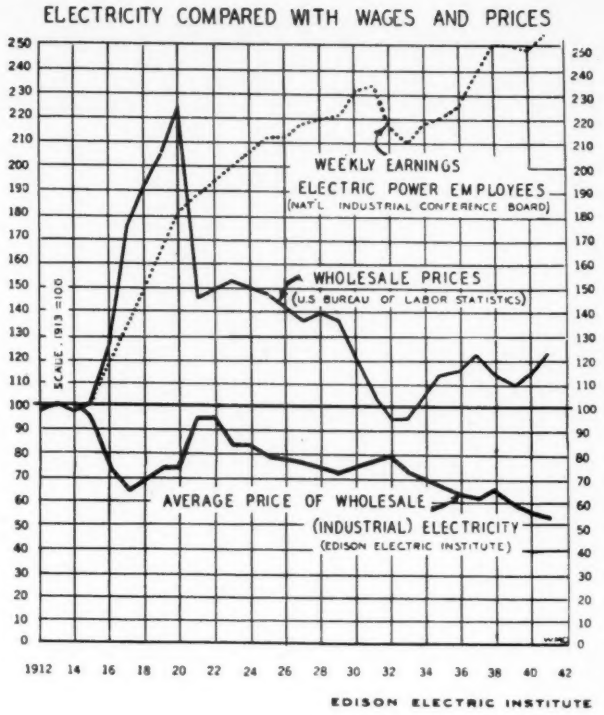

Chart 2

dends thereon. As shown in Table 1, the net income available for stock in 1941 was approximately $539,000,000. Dividends paid, both preferred and common, aggregated about $450,000,000.

The estimated increase of $144,000,000 in utility Federal taxes for 1942 over 1941, as shown in Table 2, representing over 30 per cent of all dividends paid by utilities last year, can be taken only from the stockholders—there is no other source for these funds. The state of public utility credit in recent years has made the sale of their securities so difficult that it has been necessary to expend for extensions to public utility plant large amounts of net earnings which should have gone in dividends to stockholders. In 1940 and 1941 combined, some $182,000,000 of net earnings had to be so withheld from stockholders. To the extent that net earnings may be still further reduced by increased taxes, payments to stockholders will have to be cut still deeper.

Necessity for Allowance for Growth

The electric light and power industry throughout its sixty-year life span has been and still is a relatively fast growing business. Its present long term trend of normal growth, including the depression period, appears to be about 4 per cent compounded annually. Actual growth during the past six years has been much faster. Power production has increased at the rate of 9 per cent compounded annually, and gross revenues over the same period have in-

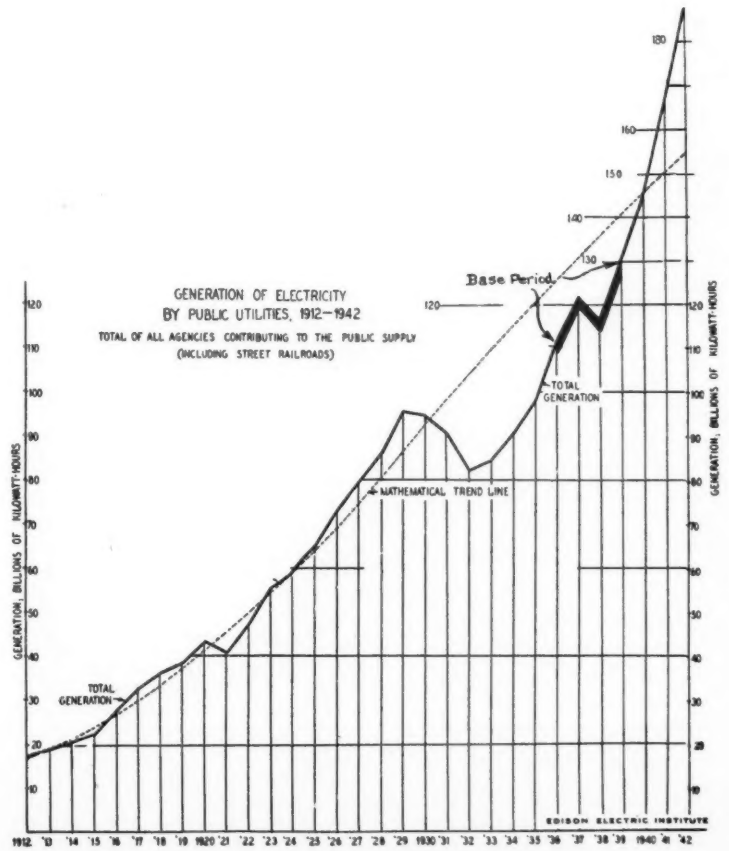

Chart 3

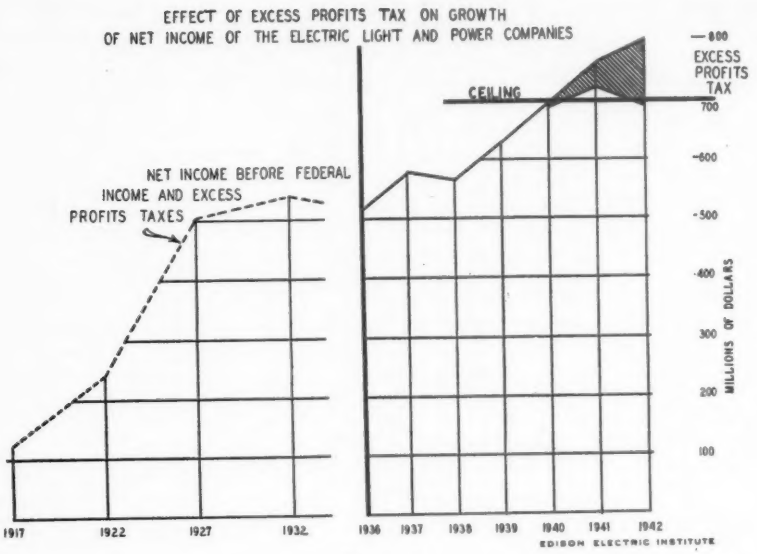

Chart 4

creased about 5 per cent compounded annually.

Thus, by the end of the present year, a normal growth of at least 12½ per cent would naturally have taken place since the end of the base period for computing Federal excess profits taxes. Chart Number 3 shows power production year by year and the mathematically computed curve of normal growth. Income requirements to maintain the expanded business this chart indicates are bound to increase somewhat in the same proportion.

To impose a stationary base or standard of income for tax purposes on an expanding business requiring heavy capital investment in plant and facilities is to class as excessive that part of normal income which really pertains to its natural growth. The effect of the excess profits tax has been to place a rigid ceiling on a vital and growing industry and the longer it remains fixed the more it will threaten the financial stability of electric utility companies. Chart No. 4, and Table No. 4 illustrate the effect of making no allowance for the growth factor.

The table shows that the ratio of Federal income and excess profits taxes to net income before deducting such taxes has climbed from 5 per cent during the last war to the prospect of 45 per cent in the first year of the present war.

3. Deferred Maintenance

Shortage of materials and labor is bound to result in the deferring during the emergency of considerable maintenance of utility plant. This will become more pronounced as the war progresses. The Interstate Commerce Commission has recognized this situation as concerns the railroads and authorized them to set aside reserves for deferred maintenance. The electric utilities should also be allowed to make reasonable accruals for this purpose. The money thus accrued could be invested in war bonds until peace is restored. This would serve to provide employment in the ensuing readjustment period.

4. Remedies

Having in mind the conditions above recited, the following remedies are suggested:

1. Exempt utility companies from excess profits taxes, since being regulated as to earnings by governmental bodies they are precluded from true excess profits; or, as an alternative, allow utility companies to deduct income and surtaxes in computing excess profits net income, as was provided in the 1940 Revenue Act.

2. Allow the deduction of one-half of all dividends paid in the computation of corporate gross income for tax purposes. It is believed that this modification could be made without loss of income to the Treasury, since the taxes thus saved by the utility companies would be paid by their stockholders in individual income taxes. The reason for this is that, since it is impossible for the utilities to avoid paying their costs of operation as well as taxes and other fixed charges, the entire increase in their Federal taxes will have to be taken away from their stockholders in the form of reduced dividends.

3. Provide an allowance for an expanding industry with a large investment per dollar of annual sales in order to alleviate the hardship arising from the use of a stationary base period in determining what constitutes excess profits.

4. Allow a deduction for reasonable reserves to offset maintenance deferred on account of shortage of materials or adverse labor conditions.

Frederick A. Allner

FREDERICK A. ALLNER, president of the Safe Harbor Water Power Corp. died at the age of 60 on July 18 at Baltimore. Recognized as one of the leading electrical engineers of the country, Mr. Allner's engineering career began in Canada where he was associated with the Montreal Locomotive Works and later with the Shawinigan Water and Power Co. In 1909 he went to Lancaster County, Pa., in connection with the hydro-electric development which the Pennsylvania Water and Power Company completed and placed in operation in the Susquehanna River at Holtwood, Pa. He was first assistant chief engineer, then general superintendent, later becoming vice-president.

He became general superintendent of the Safe Harbor Water Power Company in 1929 and was elected president of the corporation in 1940. In the whole development of the regional supply of power from these two important developments on the Susquehanna River, Mr. Allner had long been in charge, not only of the supervision of engineering work and of operation, but in the negotiations of power supply contract.

Mr. Allner took an active interest in civic affairs and participated in the activities of national engineering societies over a long period.

John C. Hays

JOHN C. HAYS, executive vice-president and a director of the Stone and Webster Engineering Corp., died on July 21 at his home in New York in his 61st year.

An electrical, mechanical and civil engineer, Mr. Hays was born in Tulane County, California, and was educated in preparatory schools of Oakland and Berkeley. Starting in 1899, he engaged in hydro-electric construction work in California. After 3 years of industrial and construction engineering in the East, Mr. Hays returned to California in 1906 where he became president, general manager and construction engineer of a group of utilities and hydro-electric projects including the Mount Whitney Power Co., Yosemite Power Co., Tuolomino Power and Light Co., LaGrange Water and Power Co. and the Mount Shasta Power Co.

He became affiliated with the Stone and Webster Engineering Corp. in 1919 and was made a vice-president in 1929 with offices in New York. He became executive vice-president in 1938.

Getting the Best Out of a Small Budget

Advertising—Public Relations

Director of Public Relations, The Connecticut Light and Power Company

By Charles J. Allen

A paper presented at Public Utilities Advertising Association Meeting, New York, N. Y., June 23

How Big Are You?

SOME years ago at a public utility convention I read a paper on some phase of accounting which apparently made an impression on a few of the delegates. After the session someone inquired about the size of my company.

"We have more than 125,000 meters," I told him proudly.

He puffed at his pipe once or twice, nodded his head and drawled:

"Hm. That's a pretty good sized outfit. It just equals our annual growth. We added about 125,000 meters last year." What my friend was telling me was that his outfit spawned a Connecticut Light and Power Company every spring.

Well, ever since then I've had something of an inferiority complex about our company's size and for years I've watched with interest the programs of all sorts of conventions where big companies dominated the program and the fellow from the smaller company sat around listening and wondering. We've grown some, from my accounting days, until now we have about 200,000 customers, including electric, combination and gas. In case you're interested in the meter statistics, there are 181,000 electric, and 76,000 gas meters. We're scattered over 106 Connecticut cities and towns, our largest city being Waterbury with a population of about 100,000.

In our set-up the merchandise advertising is handled by our sales department while informational and so-called institutional advertising is prepared by our public relations department, but in this discussion all activities will be merged and the entire advertising-publicity-public relations problem of our relatively small company will be considered as a whole.

Some Minor League Headaches

The big company, operating in a metropolitan area, can decide, when necessary, to take full-page advertisements in the largely circulated papers in its territory. The small company, particularly the one serving a comparatively large rural area, settles for 20 inches of space or less in its numerous small dailies and weeklies at the same proportionate expenditure. The smaller company must struggle for as much attention and readerage for its small ad in the Olneyville Clarion as the big metropolitan company demands for its full-page ad in the Big Town News. Therefore, its advertising man must try to pack all the selling power he knows how into his little ad if he has any hopes of gaining a reasonable percentage of the readers that a good-sized ad attracts from size and appearance.

The big company is able, if it wishes, to hire a good advertising agency. The little fellow has two choices—dream up his own ideas or steal them—well maybe borrow is a better word.

The big company can buy high-priced and "name" art-work. The little fellow must depend on syndicated stuff or a local back fence artist.

The big company can design almost any kind of an ad and be reasonably sure of at least fair reproduction in the well equipped metropolitan dailies. The little fellow tosses on his nightly pillow, beset with nightmares of bendays, halftones and reverse plates because he knows that the Daily Blatt and the Weekly Clarion are doing the best they can with worn-out presses which may make his nicely designed ads look like a mud-pie.

Of course, I don't have to tell you that I know that the large companies have real problems of their own. What I'm trying to say is that the small company's advertising problems are much different from those of the big company, even though I know that many big companies serving wide areas also have similar problems outside their metropolitan centers.

That Guy Ain't No Advertising Man

Any suggestions I make will not be cure-alls for the troubles of the small companies. I'm just a fellow who used to earn his living at bookkeeping and because I slipped an occasional wisecrack into my accounting instructions people started to say—yeh, he's probably all right but where he really belongs is in the public relations field. So I left my nice, cool accounting work, where two times two are four and you can always look in the book and get the answer, and I got into this crazy business. That should clear up any misunderstanding that might exist concerning my qualifications for telling an advertising man what to do about his budget, small or large.

Small Company Contrasts

You can't just drop a company into the small classification and proceed to prescribe. Take neighboring company A of ours, for example. It operates in a good-sized Connecticut city which has two well-run and prosperous newspapers. The Advertising Department can run a swell full-page ad in both papers and survey the result with justifiable pride of accomplishment. Now, again I'm not contending that company A's problem isn't just as difficult as ours but only that the problems of A and B are entirely different even though they are both comparatively small companies. We're not much larger than company A but our scattered customers read 38 newspapers. We have to apportion our advertising among the 38, thus eliminating any possibility of full-pagers. And woe betide us if we run the ad in the Squeedunk Bugle and pass up the Olneyville Clarion. Our local manager calls in to tell us that his Chamber of Commerce wants to know what's the matter with Olneyville, and hadn't we heard—it's the fastest growing town in Connecticut.

Or maybe we'd like to do a special war display job for the Squeedunk store. It'd look swell and cost only 34 bucks. But we can't high-hat the Olneyville store or any of the others, so we have to order 27 sets, and the $34 has skyrocketed to $875, including that extra special microscopic quantity discount. Sure, we're a small outfit but some of

the small outfits have some headaches that couldn't throb much harder if they were ten times the size. Or maybe, like our friends at company A, we have a nice piece of news about the 45,000-kw unit we're adding to the power plant. At company A the manager had lunch last week with the city editors of both papers and he knows they're continually looking for hot news like that. "Sure, we'll send a reporter over right away and how're chances for some pictures? We'll run a series—before and after." And A's customers read and are impressed. But we—well we just multiply A's two city editors by 19 and we're back again to 38.

Newspaper Advertising

A strong believer in newspaper advertising for our type of territory, I wangle all I can out of a thriftily capable New England management. We can do little splash advertising and so we struggle to get results with a minimum space expenditure in the 38 papers. We'll spend about $30,000 in 1942 on newspaper advertising. Our rates vary from 69 cents down to 15 cents an inch.

Practically all of the $30,000 will be spent for advertising of the informational type. Rates, taxes, high-cost-of-coal and other materials, Electricity Is Cheap, Keep - Your - Appliances - In - Condition, Better Light, and the other topics too familiar to all of you to need detailing.

Last year we ran a short series of weekly half-page ads in each of our newspapers on the Electricity Is Cheap theme. Eight ads cost us $9,250. We followed up with a Customers' Contest in which prizes were offered for the best answers to questions which had been covered in the advertisements. The contest was announced in our Bill Insert and we did no special Contest advertising, because one of our ideas was to use the contest as a gage of our Bill Insert readerage.

Over 15,000 booklets, in which the advertisements were reproduced, were taken from our counters by customers who had read the announcement in the Bill Insert. Something over 2,100 customers entered the contest, in which they undertook to answer such questions as—How much has the average cost of electricity to the Connecticut Light and Power Company customers been reduced since 1920?—How much does it cost to use a 100-watt bulb three hours under our low rates?—and the like. I followed it up with a talk before clubs and organizations in our territory in which the Electricity Is Cheap ads were offered as a sample in my scheduled talk on Advertising and Publicity. The additional cost of the campaign, including 15,000 booklets and the 103 prizes (100 pin-up lamps and three grand prizes) was $589.

But our appropriation won't stand even occasional half-page ads as any sort of a steady diet. This year, we've been running a once-a-week single-column, 20-inch ad in which we try to chat with the customers about our mutual problems. We fight for position and use a layout calculated, we hope, to attract attention. Apparently it's attracting some because meter readers, trouble men and other employees tell us of comments made to them on their daily rounds by Mrs. Housewife. Reddy Kilowatt, whom I'll talk about a little later on, is a useful device for this sort of column because of the chattily informal atmosphere he creates. I've brought along some samples of both the Electricity Is Cheap ads and the column, which some of you small company representatives may be interested in.

Newspaper Publicity

Kimball Jack, in his well written *Plain Talk On Public Relations,** said "More effective than advertising is the news story—news stories soar on swift, light wings of credibility." We've been able to get excellent co-operation from our newspapers, largely because of good local contacts through our managers, and because we don't try to put over advertising in the guise of news. Treat your small-town editor fairly and you'll find it pays dividends in mutual trust and understanding. Anything we send out has news value to our papers even though it tells a company or an industry story. No tiresome plugs, no long-winded lay-sermonizing about what our wonderful company is doing now for its lucky customers. And, therefore, a minimum amount of blue-penciling of our stuff by the editors, and less inclination on their part to toss the whole thing into their already well-filled wastebaskets. As a result we got over 5,000 inches of publicity last year in our customers' papers. I know that's peanuts alongside the big company totals but it's a fair batting average in our minor league.

Bill Insert

Long ago our people decided that you can't get results by stuffing bill envelopes. We send only one enclosure with our bills—The Connecticut Light News—a little four-pager. We try to keep it chatty, interesting. Always a full-page picture on page one. The third is the Women's page — Recipes, Household Hints. The other two pages usually carry newsy stories or items of interest to the customers—our new meter reading plan, how to take care of your refrigerator, at Christmas a signed message from the District Manager. We print three editions, electric, gas and combination. Much of the material is common to all three with special electric, gas or combination stories for that issue.

It costs us $9,250 a year for the 187,000 monthly copies distributed to our domestic customers. This figures 4 mills per copy, or less than 5 cents for the twelve issues.

Stockholders' and Employees' Reports

In budgeting the Stockholders' Report we consider it as an activity of the Secretary-Treasurer's department, and the cost is included in that Department's expenses. It is sent to our 22,434 stockholders (19,764 Common and 2,670 Preferred) and costs about $3,400. Our Employees' Report, distributed to our nearly 2,000 employees, costs $500 overall. This report is written in unusually simple English—as a matter of fact, on the fifth rewrite we were still conducting a witch-hunt for anything larger than a three-syllable word. We think our friend Joe Gaspipe read it through. It's no literary epic—we wrote it for Joe. We're fortunate in having executives who know that no matter how well written an employees' message may be it's worth exactly nothing if the employees won't read it. Far, far too many messages—yes, and advertisements—are designed for the executive desk and if I'm to judge by much of the excellently written but frightfully dull material that I occasionally see, there are far too many of us preparing material exclusively for what a lineman friend of mine calls the upper classes in our organizations.

Our Hollywood Department

I think our movie situation is as illustrative as any other activity in showing the length to which the small fellow will go to accomplish something without using any jack

We are now showing at Service Clubs and other organizations a 16 mm. Kodachrome movie "Powerful Connecticut." Don't let the title fool you—the scenario was written and the movie taken by our modest little staff. Our out-of-pocket cost? So help me—$250. We'd often

* EEI Bulletin, Aug., 1941.

been asked by service clubs and others for a speaker to tell the story of what we were doing in the war. But how to do the trick. We had gravely listened to a competent movie maker who was proposing for us a really good $15,000 movie—later scaled down to $10,000. We might just as well have been discussing the purchase of Warner Brothers, with Rosalind Russell and Clark Gable thrown in.

We groped around, wrote three or four scenarios, threw them away and finally settled down to what we finally used—a single reeler, 500 feet, running twenty minutes. It includes shots of the addition to our power plant under construction and then shows a factory manager consulting our district manager about electric capacity for his war plant. Follows the actual building of the necessary line to serve the factory, step by step from the layout, through the pole and line erection to the completion, with the factory wheels turning, the tanks rolling out, and the planes and bombers booming skyward.

To give it interest to make up for the lack of sound we made it in full color. We preferred not to have sound dubbed in because its absence enables us to localize our talk at each showing. In order to attract more local interest we've taken a shot of each of our district managers talking with a local industrialist, and before showing it in Olneyville we splice in the local pair and their showing never fails, as the audience recognizes the two home-town boys, to result in applause and friendly shouts of "When y'u going to Hollywood, Al" and other friendly jibes.

Unwilling to travel under false colors we're careful to explain that this line wasn't actually built in Olneyville, but that Division Manager Al Jourdan and Factory Manager Ed Harris are pictured because they are Olneyville representatives, and the work done is typical of what has often been done and will be done again right here in Olneyville.

I don't want to talk too much about our more than modest moving picture but I think it's a real index of how the small company tries to solve its problem by substituting ingenuity for jack. Nor do I want to brag about the picture. We spent two hundred and fifty bucks and we've got a two hundred and fifty buck picture.

Something we never thought about until we gave the picture its *world premiere* at Winsted, Connecticut, was the fact that every group contains a number of amateur or semi-pro photographers. At each showing there is somebody who takes issue with any disparagement of our film and starts in to prove it's a good job. Of course it isn't, but I do think that in our situation it's a good public relations tool and it's already earned its keep.

It's sacrilegious even to mention our film in the same breath with the magnificent sound-equipped jobs of some of our better heeled friends. All hail to those who have done a real job. We pay tribute to them in our pre-showing talk and point out that our effort cost a total of $249.65, exclusive of our own time. And at the same time we express the pious hope that in other and better days to come we'll be able to do a *good* job.

Customers' Information Booklets

In between times we turn out an occasional Customers' Information Booklet. Typical is the one in which we explained our seasonal rate set-up to the customers who spend their vacations in our territory, in which is included much of the lovely lake and shore country of scenic Connecticut. A second booklet—For Your Information—tells a similar story to our regular customers.

The two thousand dollars which we budgeted this year for these items will indicate the necessarily modest scale on which they're prepared but we hope they're interesting and attractive enough to earn their quota of customer circulation.

Personnel

The Advertising and Publicity personnel in our Public Relations Department consists of four people (two men and two girls), and myself. Back in my accounting days I'd refer to one of the girls as a half-girl. Not that she hasn't a full complement of arms and legs but because she works only part-time as she handles stenography and clerical work for the entire department, which includes other activities. The other girl takes care of our clip sheets, mats, mailing and the like. The two men originate our copy and handle layouts and miscellaneous activities, including photography. The separate Sales Department has one man who as Merchandise Advertising Manager handles Promotional Advertising. He's really an advertising man—I'm just an old bookkeeper gone wrong. I've included his expenditures in the totals below which show our entire Company program. There are two other employees who should be mentioned, one in charge of Employee Training, the other the Editor of our employees' magazine, *The Spotlight,* but I haven't included them in my figures because they have nothing directly to do with our advertising and publicity.

Company Employees

But I mention the last two because we all know that every company, small or large, has an excellent advertising-public relations agency in its employees. But your small town dweller, naturally, knows a relatively higher percentage of his fellow townsmen than does the large city dweller. The Olneyville Manager will know half his townspeople personally. And so, to a degree, will the meter man, the lineman, and the trouble man, and the other employees. We occasionally reproduce our advertisements in our employees' magazine, and good use of them is made by our Supervisor of Employees' Training. (That's a nice title but he's also the Assistant Supervisor, answers his own telephone and runs a strictly one-man show. Years ago he went to the best business school in Manchester, New Hampshire, which was a break for him because he does his own typing too.) Last year he based his current Employee Training Course on the Electricity Is Cheap theme and used our advertising series as a spring-board from which to launch a discussion of electric rates in general, and our own in particular. And he did a good job of advertising and public relations in the process, even though he may have considered it a strictly employees' educational activity.

Because he gets around to our districts, came up out of our ranks and knows many of our employees intimately, he's a one-man Gallup poll. Too many of us go over to the University Club for lunch and trade opinions back and forth among the same fifty or sixty acquaintances, and return to our desks thoroughly convinced that we've got the answer to what the man in the street—I call him Joe Gaspipe—is thinking about. What we've actually been doing is airing our minds with lads who think just like us and hold the same opinions on economics, Washington, and the utility business that we hold. Some of our most opinionated friends will forecast at a moment's notice—and often on no notice at all—just what's going to happen in the next election My only reaction is—how can they possibly know. Like nearly everybody they only consort with one comparatively small group. And boy! Do they bat a thousand in the Wishful Thinkers league.

But take the small company utility office manager, commercial manager, engineer, lineman, service man, meter man, and above all the Information and similar customer-contact employees — put them all together, they spell knowledge of local public opinion. Only if you want to know what *they* know be sure of one thing—ask 'em, don't tell 'em. And in asking them don't phrase the question so the subordinate figures you have the answer, and that you'll mentally label anyone who doesn't agree with you as just a dumb cluck.

Employees' Magazine

Our Spotlight Editor keeps in mind that while he's sure of his circulation he's not nearly as certain of his reader interest. Every attempt is made to attract and hold this interest through numerous personals, names and pictures of employees and families. There are some messages in each issue which tell the story of Company activities and policies. The Editor balances on his monthly tight-rope, hoping that he has enough of both the light and the serious. He knows that the serious articles pay the freight but he is also fully conscious that a streamlined locomotive powered by personals is necessary to pull the baggage car. Our 2,300 copies cost us $2,700 a year, or a little less than 10 cents a copy.

A Good Printer Is Invaluable

We are fortunate indeed in having in our territory some good printers who help us over the mechanical bumps. And we've found out that the thrifty shopper can do all right by himself on the small town printing circuit. The small company advertiser will make no mistake in spending some time looking up a good printer, if he already hasn't one. Preferably one with an inexpensively operated art department and a full complement of type. Boy—how they can do tricks for you and pull layout rabbits out of the hat when you're all ready to go haywire. There are a number of good ones in our small territory. In the comparatively small city of Meriden there's an excellent outfit whose one-man art department has often transformed our who's-going-to-read-them ads into something very different, through the medium of a few illustrations, a new type set-up and a changed-around layout. Check your printing costs, but don't shift around because a salesman drops in with an offer to do it at a lower price. You should pay for that extra service—it's often a life saver And don't waste time and money fooling around with a young art student who's learning the business conscientiously but at your expense A good printer will solve that problem for you.

And Reddy Kilowatt Too

I'm not on Ash Collin's payroll but why wait for the old guy to die before we say a kind word about that venerable citizen. You can do a lot of tricks with Reddy. We don't use him for everything but there's many an occasion when he can save you time and money. We used him on a we-can't-give-you-as-good-service customer's letter recently and our Managers were warmly complimented by customers. I thought it was just a so-so letter but the Thank-You Reddy down in the corner apparently took the curse of formality away. We've used Reddy in our chatty newspaper column that I've referred to previously, and we've found him adaptable. We use enough of Reddy's mats to pay the freight. Yes, Reddy's a help.

What to Do

The very best thing I know of to do about a small budget is yell like hell for more. Of course that action has one drawback. After you find another job you may be faced with an even smaller personal budget.

All Right—What's Our Budget?

Newspaper advertising	$30,000
Bill insert	9,250
Window and store displays	4,000
Institutional Booklets (Customer information)	2,000
Sales promotional material	940
Company truck signs	800
Photographic expense, layouts, special art work (including moving pictures)	1,100
Annual report to stockholders	*
Annual report to employees	500
Newspaper publicity, cuts, mats, etc.	400
Miscellaneous expenses, including Reddy kilowatt service	1,920
Total	$50,910

*Included in Treasurer's Budget—$3,400.

And Now—

One of my wisest acquaintances often quotes—the braggart soon loses his friends if he ever had any. I think—generally speaking—he's right but then a good deal of time is wasted in this world by people who are trying ever so hard to be professionally humble. You can often save time by just telling your story as you see it and run the risk of appearing to claim too much for too little. If somebody thinks you're bragging—well you'll have to grin and bear it. But the mere title of this little escapade into literary adventure smacks of real bragging—How To Get The Best Out Of A Small Budget. Wish I knew how. But we do struggle to do the best we can with our small budget and if, as is undoubtedly true, we don't get the best out of it it isn't because we fail to apply what, for lack of a better designation, we call our minds. And just before you all burst into tears at the horrible situation the small company public relations director finds himself in, I ought to tell you—it's a great job—I love it. There's only one thing I love more:—that's the opportunity to associate with you folks from the big companies who do a real job. I listen attentively and mentally sort and classify your ideas, making up my mind which ones to steal. After making that important decision I usually have only one other problem. How to get results with them without using any jack.

New Edition of Lineman's Handbook

A NEW edition of The Lineman's Handbook by Edwin B. Kurtz is now available. The first edition appeared in 1928.

The handbook is intended primarily for linemen, and groundmen who are looking forward to becoming linemen. The style of the book is simple and easily understood and is backed up with 682 illustrations, diagrams, charts, tables, and other reference aids.

Reading and studying the book should give the lineman a good understanding of the elements of electricity, distribution circuits, apparatus, materials, construction and maintenance tools, and the step by step processes followed in line erection, inspection, and maintenance. The chapter headings are:

I. Elementary Electrical Principles.
II. The Electric System.
III. Distribution Circuits.
IV. Line Materials.
V. Line Equipments.
VI. Line Protective Equipment.
VII. Line-Control Equipment.
VIII. Fundamentals of Line Design.
IX. Pole-Line Erection.
X. Tower-Line Erection.
XI. Inspection, Testing, and Maintenance.
XII. Rural Lines.
XIII. REA Manual of Operation and Maintenance Practices of Rural Lines.
XIV. Safety Methods in Construction of Overhead Lines.
XV. Pole-Top Resuscitation.
XVI. First Aid Talks.
XVII. Accident Prevention Course for Linemen.

The book contains 652 pages, and sells for $4.00. It can be secured directly from the publisher, McGraw-Hill Book Co., 330 West 42nd St., New York, N. Y.

Quarterly Meter Reading with Monthly Billing

By John A. Williams

Assistant Controller, Niagara Hudson Power Corporation

DUE to the current necessity of reducing automobile mileage, the Niagara Hudson System companies introduced a plan of quarterly meter reading, as of June 1, 1942, in all territory where it is necessary to use automobiles to read meters.

The companies have 198,000 meters in automobile routes and 850,000 meters in walking routes. No change was made in the practice of reading walking route meters monthly.

The automobile route meter books were divided into three groups: with one group scheduled for reading in January, April, July and October; another group for February, May, August and November; and the third group for March, June, September and December.

Bills are rendered on a monthly basis, as previously, with bills in the intervening two months based on estimated use or by customers' return post card readings, at the customers' option. The customers having demand meters or gas house heating service are read monthly either by service men or regular meter readers, depending upon which can handle the reading with a minimum of overall traveling time Seasonal accounts are read monthly during the summer months or quarterly, depending upon the conditions in the resort area.

This plan of quarterly meter reading was approved by the Public Service Commission of the State of New York through approval of a revised general information sheet. Exhibit A, which was made a part of the regular rate schedules of all System companies.

Letters were addressed to all customers affected, explaining the plan and providing for customer's reply in case the customer elected to read his meter during the intervening months under the return post card plan. Newspaper releases were also used to give the plan wider publicity and to let customers in the urban areas know that the company was taking effective steps to meet the emergency.

The customers' response to the announcement of the plan was exceedingly fine. Approximately 10 per cent of the customers made requests to have their accounts billed under the return post card plan during the intervening months.

Where customers elected to use the post card reading plan, a special addressograph plate file was set up for addressing the post cards each month. Return post cards, Exhibit B, are forwarded to the customers so that they will reach them at least three days in advance of the date of billing. The customers' regular meter reading sheet is

P. S. C. No. 21 ELECTRICITY

(NAME OF COMPANY)

ORIGINAL LEAF NO.
FIRST REVISED LEAF NO. 17
SUPERSEDING ORIGINAL LEAF NO. 17

GENERAL INFORMATION

21. BILLING AND COLLECTIONS:

The rates specified in the various service classifications are stated on a monthly basis. Bills will be rendered monthly and may be rendered by (a) depositing the same in a U. S. Post Office or in a box or chute provided for that purpose by the U. S. Post Office Department, addressed to the Customer at the premises where service is taken, or at another address designated by the Customer, or (b) by leaving the same at the building where service is taken. Bills are due when rendered and Customer is in default unless payment is made at or is mailed to a designated office of the Company on or before the last discount date appearing upon the bill, which date shall be ten (10) business days subsequent to the date bill is rendered. Payment must be made without regard to any counter claims whatever and failure to receive a bill does not relieve responsibility for payments of amounts due.

Company will endeavor to read meters at regular intervals. Whenever the bill for service is predicated in whole or in part on a demand reading, meters will be read monthly. Whenever the bill for service is predicated on kilowatt-hour consumption exclusive of demand, meters will be read monthly, bi-monthly or quarterly at the option of the Company. Company may designate areas within its franchise territory where meters will be read monthly, other areas where they will be read bi-monthly and still other areas where they will be read quarterly.

In those areas where the Company elects to read meters bi-monthly or quarterly, Customers affected thereby will be notified in advance and shall be given the option of (a) reading their own meters, or (b) accepting estimated readings for the intervening month or months during which the Company does not read the meters. In case Customer elects to read his own meter, Company will, on each meter reading date, supply Customer with a stamped printed postcard addressed to Company's office on which Customer shall indicate the position of the hand on each dial of his meter as of a specified date and mail to Company's office. Customer's bill for that month shall be determined therefrom. In case Customer elects to accept an estimated bill or in case Customer fails to mail postcard promptly, Company shall estimate the kilowatt-hour consumption for billing purposes on the basis of Customer's consumption during the corresponding month of the preceding year, or on the consumption during the last preceding month or on such other information as may be available. The amount by which the kilowatt-hours taken during a bi-monthly or quarterly period exceeds any kilowatt-hour consumption which has been estimated for a part of the period, shall be considered as having been taken during the month immediately preceding the reading of the meter by the Company.

If, for any reason, the monthly bill is rendered for a period more than five days longer or shorter than normal, the stated monthly rate shall apply pro rata.

DATE OF ISSUE APRIL 25, 1942 DATE EFFECTIVE, MAY 25, 1942

Exhibit A

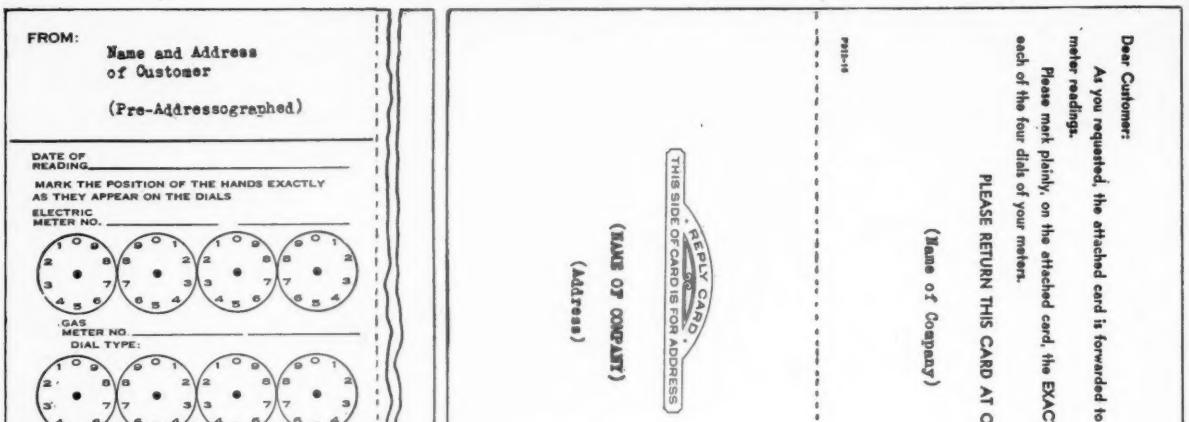
FROM:
Name and Address of Customer
(Pre-Addressographed)
DATE OF READING
MARK THE POSITION OF THE HANDS EXACTLY AS THEY APPEAR ON THE DIALS
ELECTRIC METER NO.
GAS METER NO.
DIAL TYPE:
DIRECT READING TYPE:
00
IF YOU PREFER AN ESTIMATED BILL IN THE FUTURE PLEASE MARK HERE
Your cooperation in reading your meters and mailing this card promptly will be of much assistance and greatly appreciated.
(Name of Company)
REPLY CARD
THIS SIDE OF CARD IS FOR ADDRESS
(NAME OF COMPANY)
(Address)
Dear Customer:
As you requested, the attached card is forwarded to you for the entry of your meter readings.
Please mark plainly, on the attached card, the EXACT position of the hands on each of the four dials of your meters.
PLEASE RETURN THIS CARD AT ONCE.
(Name of Company)

Exhibit B

stamped "Post Card" for reference purposes.

As post card readings are received, they are entered on the customer's account in the meter book in ink, followed by the designation "X" to distinguish these readings from estimated readings. Where no post card has been received on a post card reading account by the day of audit, an estimated bill is rendered.

During the regular reading month, if the meter reader is unable to obtain access to the customer's premises, he leaves a doorknob card with business reply indicia printed on the reverse side, asking the customer to read his meter immediately and return the card for billing purposes. If the card is not received from the customer at the time of billing, the reading for the third month is estimated and a follow-up by a service man for verification of the reading is made. Accounts having demand meters or gas house heating are maintained in special books for reading purposes and the readings are transcribed to the regular route after they have been read.

Estimated readings for the intervening two months are made which will approximate as closely as possible the customer's actual use. In determining the estimated reading, the audit clerk takes into consideration all factors which might affect the amount of a bill. These include the average use for the past few months, the use for the same month last year, the season of the year as to whether the days are becoming longer or shorter, and any factors affecting individual accounts which may be known to the audit clerk, such as seasonal operation of brooders and heaters, etc. Where the actual reading for the third month is less than the estimated reading of the previous month, or where it produces a minimum bill which makes the total of the three bills greater than the bill would have been if the account were figured on a three months' prorated basis, the billings for the estimated readings are cancelled and a corrected bill is issued. The corrected bill with credit thereon for estimated bills paid is forwarded to the customer with a letter of explanation.

Where post card readings are received from customers after an estimated bill for the month has been prepared, the card reading is checked with the estimated reading to determine what discrepancy exists between the post card and the estimated reading. If little discrepancy exists, the post card reading is noted in ink in the "Remarks" opposite the month of reading as "X-(Reading)," and the card is filed. If there is a considerable deviation between the two readings, the estimated readings are cancelled by adjustment and a corrected bill is rendered.

Letters are sent to all new customers in the quarterly meter reading areas advising them of the fact that their meter will be read quarterly and also advising them of the fact that the return post card readings may be used if the customer desires.

A space is provided on the return post card so that the customer may request that the use of the card be discontinued and that estimated readings be used thereafter. A number of the customers have already made this request. It is estimated that after the plan is in operation for a year or more, that not over 5 per cent of the customers will continue to use the return post card method of reading.

While the primary purpose of the installation of this plan was to conserve automobile mileage (a reduction of some 600,000 miles annually is estimated), consideration was given to the fact that savings can also be made in meter reading costs, and this change in meter reading should bring the automobile route meters down to an annual cost comparable to the cost of reading walking route meters.

While the plan has not been in use long enough to determine final results, all indications point to the fact that its operation will be completely satisfactory to the company and to the public.

Coordination of Distribution and Power Supply System Voltages

By C. E. Arvidson
The Commonwealth & Southern Corporation

A paper presented before the Transmission and Distribution Committee, EEI, at Chicago, May 4-5, 1942

FEW, if any, electricity supply company engineers take exception to the concept that the voltage requirements of the distribution system should dictate the voltages to be maintained on the power supply systems and at the distribution substations. It is questionable, however, whether or not some engineers follow through with their conceptions in the selection of new equipment and in the use of existing facilities.

Available voltage data indicate the probability that some engineers may not be giving sufficient attention to the proper coordination of distribution system voltage requirements, operating range of voltage regulators, available taps on distribution supply transformers, transmission supply voltages, etc. It is also apparent that some engineers have begun to realize, only within the past few years, that the voltage ratings of the secondaries of distribution substation supply transformers should be higher than the ratings of distribution transformers in the same voltage class.

During the present emergency, it may be necessary for electric utility companies and their customers to condone service voltages which may not be entirely adequate, but such conditions should not be tolerated until optimum use of existing facilities has been made. Therefore, this should be an opportune time to review some of the principles which must be recognized if the distribution and power supply system voltages are to be properly coordinated.

Voltages Required at Distribution Substations

The voltages required at distribution substations are governed by the voltage requirements and the characteristics of the distribution system served therefrom. The maximum *regulated* voltage at any distribution substation is required during full load conditions, and is equal to the maximum distribution primary voltage which is desired at the feed point, or first transformer, on the distribution circuit plus the *greatest* full load feeder voltage drop. The corresponding minimum *regulated* voltage is usually required during light load conditions, and is equal to the desired no-load primary voltage (contact making voltmeter setting on regulator) plus a light load/full load percentage of the regulator compensation on the circuit having the *smallest* feeder voltage drop.

The regulated voltages defined above require that the *unregulated* bus voltage must be kept within limits such that the circuit regulators involved can buck the maximum light load unregulated voltage, or boost the minimum full load unregulated voltage to the regulated values required for the various distribution circuits. During light load conditions, the maximum unregulated bus voltage at the distribution substations should not exceed the minimum regulated voltage, defined above, by more than the ratio of 100/90 where ± 10 per cent regulators are used, or by more than the ratio of 100/95 where ± 5 per cent regulators are used. Similarly, the mini-

TABLE I—VOLTAGES REQUIRED AT DISTRIBUTION SUBSTATIONS
(All voltage values expressed in terms of 120 volt base)

		Case I ±10% Regs.	Case II ±5% Regs.
1.	Required voltage at pri. of 1st dist. transf.	125	125
2.	Desired no-load pri. voltage (regulator CMV setting)	120	120
3.	Operating range of voltage regulator	±10%	±5%
4.	For dist. circuits having 0 volts feeder drop		
	(a) The *required regulated* voltages at substation are:		
	at full load, 125 + 0 volts feeder drop	125	125
	at light load, .25 (125-120) + 120	121.25	121.25
	(b) The *required unregulated* bus. voltages are:		
	at full load, *not less* than 100/110 x 125	113.6	.....
	100/105 x 125	.....	119.0
	at light load, *not more* than 100/90 x 121.25	134.7*	.....
	100/95 x 121.25	.....	127.6*
5.	For dist. circuits having 8 volts feeder drop		
	(a) The *required regulated* voltages at substation are:		
	at full load, 125 + 8 volts feeder drop	133	133
	at light load, .25 (133-120) + 120	123.25	123.25
	(b) The *required unregulated* bus. voltages are:		
	at full load, *not less* than 100/110 x 133	120.9*	.....
	100/105 x 133	.....	126.7*
	at light load, *not more* than 100/90 x 123.25	136.9	.....
	100/95 x 123.25	.....	129.7
6.	*Required unregulated* bus voltage at substation serving several dist. circuits having feeder drops of various magnitudes from 0 to 8 volts.		
	at full load, *not less* than (limited by Item 5b*)	120.9	126.7
	at light load, *not more* than (limited by Item 4b*)	134.7	127.6
7.	*Required high tension* voltage at dist. substation (assume 5% drop through transformer at full load and 1¼% at light load). H.T. Voltage = Item 6 × (100 + % transf. drop)/100 × (100 − % tap setting)/100		
	(a) 0% tap (full wdg.)—at full load, not less than	126.9	133.0
	at light load, not more than	136.4	129.2
	(b) 2½% tap—at full load, not less than	123.8	129.7
	at light load, not more than	133.0	126.0
	(c) 5% tap—at full load, not less than	120.6	126.3
	at light load, not more than	129.6	122.7
	(d) 7½% tap—at full load, not less than	117.4	123.0
	at light load, not more than	126.2	119.5
	(e) 10% tap—at full load, not less than	114.2	119.7
	at light load, not more than	122.7	116.3

Note: All voltage values are subject to tolerance of ± 1 volt (CMV setting). *See Item 6.

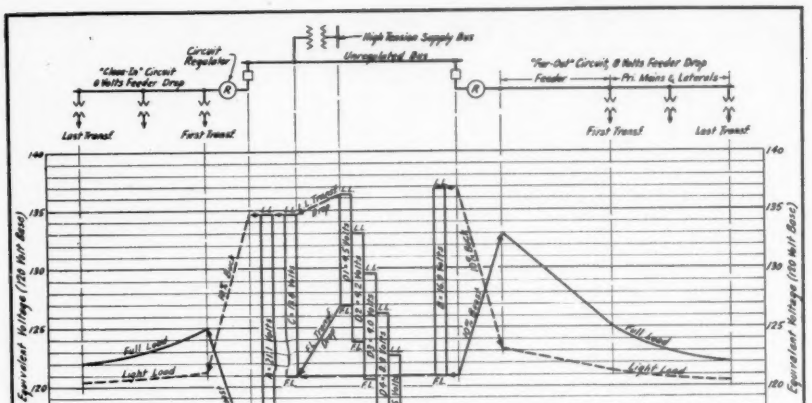
High Tension Supply Bus
Unregulated Bus
Circuit Regulator
"Close In" Circuit 0 Volts Feeder Drop
"Far-Out" Circuit, 8 Volts Feeder Drop
Feeder
Pri. Mains & Laterals
Last Transf.
First Transf.
Equivalent Voltage (120 Volt Base)
Full Load
Light Load
A - Maximum Permissible Unregulated Bus Voltage Spread & Limits for Circuits having 0 Volts Feeder Drop.
B - " " " " " " " " " " 8 " " "
C - " " " " " " " " " " Substations serving Circuits with 0-8 Volts Feeder Drop.
D1 - High Tension Voltage Limits Equivalent to (C) with Transformer Tap Setting on Full Winding.
D2 - " " " " " " " " " " 2½ Percent Tap.
D3 - " " " " " " " " " " 5 " "
D4 - " " " " " " " " " " 7½ " "
D5 - " " " " " " " " " " 10 " "
FIG. 1 - CASE I, VOLTAGE PROFILE FOR SUBSTATIONS USING ±10 PERCENT REGULATORS

Fig. 1

mum unregulated bus voltage during full load conditions should not be less than 100/110 times the required maximum regulated voltage where ± 10 per cent regulators are used, or less than 100/105 times the maximum regulated voltage where ± 5 per cent regulators are used.

The light load and full load voltages on the high tension side of the distribution substation supply transformers must be sufficiently higher than the values obtained by multiplying the required unregulated bus voltages by the transformer ratio to provide for the voltage drop in the substation transformers. *Voltage taps in the high tension (and/or low tension) transformer winding should be used to select that ratio which will place the high tension supply voltages in the proper relation to the unregulated low tension bus voltage requirements.*

The voltage requirements at distribution substations can best be realized by working out examples for specific cases. Assume, for sake of illustration, Case I, where:

(a) The distribution substation in question supplies several circuits having full load feeder voltage drops ranging in magnitude from 0 to 8 volts.

(b) The full load distribution primary voltage required at the feed point or first transformer is 125 volts ± 1 volt. (± 1 volt representing contact making voltmeter band setting.)

(c) The desired no load distribution primary voltage is 120 volts ± 1 volt, representing the voltage at which the contact making voltmeters are balanced.

(d) The characteristics of the circuit loads and the total substation loads are such that the light load is approximately 25 per cent of full load.

(e) The substation supply transformers have a no load to full load regulation of 5 per cent for the assumed load, and the high tension windings are provided with 4-2½ per cent taps.

(f) The operating range of the individual feeder voltage regulators is ± 10 per cent.

For Case II, assume the same conditions except that the operating range of the regulators (Item f) is ± 5 per cent.

The arithmetical determinations of the required substation voltages for these two assumed cases are given in Table I and the results are shown graphically in Figs. 1 and 2. These examples should be studied together with other similar examples in order to thoroughly comprehend the interrelationship of feeder voltage drops, unregulated bus voltages, high tension supply voltages and regulating range of regulators.

Correlation of Substation Voltage Requirements and Power Supply System Voltages

It can be seen from Figs. 1 and 2 that the proper coordination of substation voltage requirements and power supply system voltages must take into consideration both the voltage *level* and the light load to full load voltage *regulation* of the power supply system together with the facilities for controlling these factors.

Correlation of Voltage Levels

As previously stated, the purpose of taps in the high tension (and/or low tension) transformer windings is to provide a means of selecting that ratio which will place the *level* of the high tension supply voltages in the proper relation to the low tension voltage requirements. In some cases, the available distribution substation transformer taps may be unsuitable for the proper correlation of the high tension and low ten-

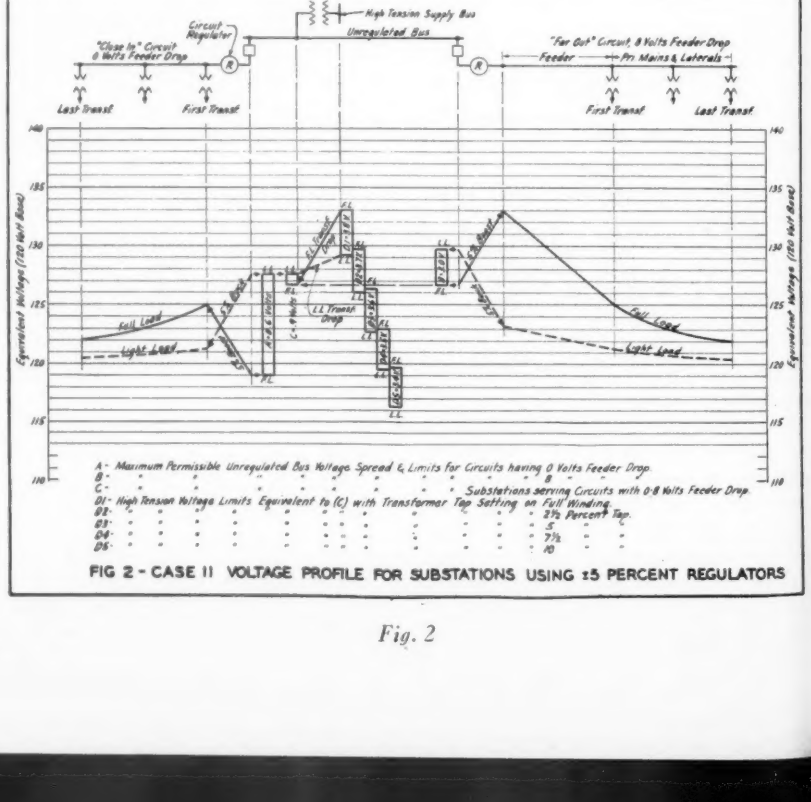
High Tension Supply Bus
Unregulated Bus
Circuit Regulator
"Close In" Circuit 0 Volts Feeder Drop
"Far Out" Circuit, 8 Volts Feeder Drop
Feeder
Pri. Mains & Laterals
Last Transf.
First Transf.
Equivalent Voltage (120 Volt Base)
Full Load
Light Load
A - Maximum Permissible Unregulated Bus Voltage Spread & Limits for Circuits having 0 Volts Feeder Drop.
B - " " " " " " " " " " 8 " " "
C - " " " " " " " " " " Substations serving Circuits with 0-8 Volts Feeder Drop.
D1 - High Tension Voltage Limits Equivalent to (C) with Transformer Tap Setting on Full Winding.
D2 - " " " " " " " " " " 2½ Percent Tap.
D3 - " " " " " " " " " " 5 " "
D4 - " " " " " " " " " " 7½ " "
D5 - " " " " " " " " " " 10 " "
FIG 2 - CASE II VOLTAGE PROFILE FOR SUBSTATIONS USING ±5 PERCENT REGULATORS

Fig. 2

sion voltage levels. This may be due to improper ratios having been specified when the transformers were purchased or it may be due to power supply system voltage levels which are too high or too low for best system operation. In either case, studies should be made of transformer tap settings at step-up and step-down transmission substations for the purpose of adjusting the relationship between generator and transmission voltage levels so that the voltage level requirements of most distribution systems can be satisfied.

Even though the voltage level of the power supply system has been investigated and improved, the voltage level at some particular substation may still be too high or too low. In such cases there are other possible expedients which should be considered, such as:

(a) Interchanging substation supply transformers to obtain more suitable transformer ratios for the critical substation locations.

(b) Installing fixed bucking or boosting transformers between the low tension terminals of the substation supply transformers and the low tension unregulated bus.

(c) Installing *uncontrolled* shunt capacitors on the unregulated low tension bus or at the feed points of the distribution circuits having the greatest feeder voltage drop.

Regulation of Power Supply System Voltages

In case the light load to full load regulation of the high tension supply voltage is too great to satisfy the voltage requirements at the distribution substation, studies should be made to determine how the regulation of the power supply system can be improved by making optimum use of existing equipment. All possibilities should be considered including:

(a) Varying the generator voltages with the load, i.e., providing "over-compensation" or "negative regulation" of the generator bus voltages.

(b) Taking full advantage of existing regulating facilities on the power supply system such as synchronous condensers, tap changing under load transformers, etc. These should be operated throughout the full buck and boost range if necessary.

Should the regulation of the high tension supply at the distribution substation be too great, even though existing facilities are being used to the fullest extent, the following expedients should be given consideration:

(a) Install *controlled* shunt capacitors on the low tension bus of the distribution substation or at the feed points of the distribution circuits having the greatest feeder voltage drop.

(b) Install synchronous condensers or additional regulating equipment at critical points on the system.

(c) Construct additional transmission lines to the critical substations.

(d) Increase transmission system voltages by changing from delta to wye operation.

Summary and Conclusions

The important concepts which should be foremost in the minds of those responsible for maintaining adequate system voltages are:

(a) System *voltage levels* are controllable by the proper specification and use of variable transformer ratios (transformer taps), uncontrolled shunt capacitors, and bucking or boosting transformers.

(b) System *voltage regulation* (light load to full load) may be improved by "negative regulation" of the generator voltages and by effective use of tap changing under load transformers, voltage regulators, synchronous condensers and controlled shunt capacitors.

(c) Voltage *level* and voltage *regulation* may be considered separately except in so far as improper voltage levels sometimes prevent the use of the full regulating range of voltage regulating facilities. The unregulated voltage level should be such that the voltage regulating equipment can buck the light load and boost the full load voltages the desired amount.

A thorough understanding of the voltage requirements of each particular distribution system and of the voltage improvement possibilities offered by various types of equipment will enable the engineer to make maximum possible use of existing facilities. In cases where the power supply system is relatively "stiff," the distribution engineer can take advantage of this condition by permitting greater feeder voltage drops if necessary; or should the distribution system have relatively small feeder drops, greater regulation can be allowed on the power supply system. Furthermore, it may be possible in some cases to improve the regulation of the power supply system to such an extent that additional distribution circuit regulator capacity can be obtained by reconnecting the regulators to ± 5 per cent operation. These are only a few of the opportunities which will "knock at the door" of the engineer who thoroughly understands the problem of coordinating distribution and power supply system voltages.

Dearborn Named Managing Director of National Safety Council

Ned H. Dearborn, of New York City, has been named executive vice-president and managing director of the National Safety Council. He succeeds W. H. Cameron, who is retiring after almost 30 years as managing director of the Council.

Since 1934, Mr. Dearborn has been dean of the division of general education of New York University, a post he now leaves. In his new position he will actively direct the greatly expanded wartime program now being conducted by the National Safety Council as a result of a proclamation by President Roosevelt.

Necessary funds for this enlarged program—aimed at stopping accidents that are impeding production and delaying victory—now are being obtained from commerce and industry by the Council's War Production Fund to Conserve Manpower.

An initial appropriation of $250,000 from this fund will be made available to the Council for immediate development of this wartime safety program, Colonel Stilwell said. An additional $1,000,000 already pledged, will be allocated within the next few months. A goal of $5,000,000 has been set to meet the minimum needs of the expanded program.

Fourth Columbia Accounting Institute

COLUMBIA UNIVERSITY'S Fourth Accounting Institute has been arranged for Oct. 19 and 20, 1942, at the Pennsylvania Hotel with NACA headquarters and local chapters as well as the New York State Society and the American Institute of Accountants collaborating.

The general committee and several subcommittees responsible for the Institute are composed of representatives of each of the participating bodies and every effort is being made to secure outstanding speakers for each of the several sessions. The following topics have been selected for the meeting:

Problems growing out of accounting for war contracts, with particular emphasis on allowable costs and renegotiation of contracts.

Problems of operating cost control within the limits set by price ceilings in relation both to war contracts and the manufacture of civilian goods.

Federal tax problems under the new tax law.

The post-war world: (a) political and social; (b) business and economic; (c) problems to be faced by the accounting profession.

A Utility Safety Program Which Brought Results

By H. O. Sprinkle

Manager of Operations, Monongahela West Penn Public Service Company, Fairmont, W. Va.

A paper presented before the Accident Prevention Committee, Edison Electric Institute

I AM NOT a Safety Director nor a Personnel Manager—I just happen to be one of the operating gang who has become thoroughly sold on accident prevention. This talk may seem to be too much of a personal experience, but I can't help it. The development of our accident prevention program over the last few years has been one of the most important and interesting features of our operating work, and the entire Department has become vitally wrapped up in it.

Until within the last few years accident prevention was one part of our job that seemed out on the margin—something to give attention to when we weren't too busy, or when an accident occurred. Of course we had a Safety Department, and a good one, too. It kept after us on first aid training, made safety inspections, sent out bales of posters and did a lot of hurrahing and award giving and all the things it could think of to sell the idea of safe work. But we were typical supervisors, it seems—we had a Safety Department, and it was up to it to look after the safety end of the work. We were taking care of building and maintaining the lines and substations. In fact it seemed to us that our principal job along accident prevention lines was to see that everyone got the necessary first aid training, and that the bulletin boards were kept up to date.

Anyhow, as I look back, it is evident that the Safety Department never got it across to us that accident prevention was *our* job, and just as important as any other part of the work. They tried hard but it just never sank in. Oh, yes, we would have told anyone that we were safety conscious, and could almost prove it, too. But the actual fact is that we never really got the idea until a few years ago. It is probably true (and a number of Safety Directors have confirmed this) that most Safety Departments come up against this very thing sooner or later. Beginning with little or no accident prevention work in a company, a Safety Department can show results for several years. Then they begin to hit a limit which they *know* does not represent a satisfactory minimum. There will always be *some* accidents since we are human beings and not perfect, but the great question is, how good can we become?

This limit was not satisfactory by any means on our property, and we decided to really apply ourselves to the problem and see what we could do about it. After all, if a supervisor is to do his job intelligently he must strive for a *complete* job, a well rounded job, one in which he overlooks no part or program which can help to make the results the best of which he is capable. And I am sorry to say we were not applying our brains to one of the most important phases—namely, ACCIDENT PREVENTION.

I had been on the property 9 years and the accident record was getting no better—in fact it was slipping a little. We all worked at it, *trying to help the Safety Department improve the record.* Do you get the point? *Trying to help the Safety Department improve the record.* It just didn't sink home that the real situation was that the Safety Department was trying to help *us* improve the record.

Here is a tabulation showing the record in the Operations Department over the years 1937, 1938 and 1939.

	1937	*1938*	*1939*
Number of Employees	609	631	566
Exposure Hours	1,135,000	1,177,609	1,130,266
Minor Accidents	59	64	40
Lost Time Accidents	57	36	11
Fatalities	3	4	4
Total Accidents	119	104	55
Frequency Rating (Total)	105.	88.4	48.6
Frequency Rating (Lost Time)	52.86	33.9	13.2
Severity Ratings	18.	21.	21.48

In explanation I may say that the Operations Department includes all line crews, line servicemen, substation maintenance crews, substation operators and meter testers. You can see that this is a terrible record. After the last fatality in 1938 we had a red-hot session and decided to do something. We held a big 3 day conference of all the general supervisors to see if we couldn't find out where the trouble lay and try to correct the trend. I was chairman of that session, and it was one of the great educative moments of my life, and all of the men felt the same way about it. There was really nothing new developed, nothing you will not find in a dozen books and innumerable articles, but let me tell you—when *you* really and truly learn something so that it becomes a part of you, you have had an experience which completely changes you from that moment on. You will never be the same again.

It is my honest belief that the men who sat in that conference learned as they had never learned before the size and scope of their jobs, and particularly that accident prevention is the logical and inescapable result of good workmanship. I will gladly send anyone a copy of the summarized minutes of that session and two other short sessions later. Just give me your name and address. Those minutes embody the entire working philosophy of our Department, and I am immensely proud that the supervisors themselves worked them out and made each idea a part of himself. As I said, there was nothing really new, except that the group actually saw the complete situation for the first time. It became a personal matter from then on. To be specific, we went over our entire program, adopted some new ideas and rejuvenated some old ones. Among other things we decided that a spirit of cooperation between workmen was absolutely essential and must be fostered. We put new life into our tool and equipment inspection on the theory that good tools would encourage good work.

We gave the personal tools of the men the same rigid inspection as company tools, and in order to avoid criticism

for condemning a tool which the workman still believed to be good we adopted the plan of paying half the replacement cost of any tool that became unserviceable. This gave both the company and the men a financial interest in the care given to tools personally owned by the men, and was considered better than paying the entire cost. Incidentally, this plan has worked out beautifully.

We went to great pains to define the responsibilities of the foreman and of the workmen themselves. Perhaps here is where we had the basic principle that was to deliver the results in our accident prevention work.

We started a "safety observation" program, but quickly abandoned it. By safety observation is meant a plan whereby some member of the headquarters staff of the department involved would visit each crew periodically for the purpose of watching it for a day or two to see how work was being performed, and make sure everything was working satisfactorily. We quit this after the second observation visit because of the bad effect it was having on the morale of the men. Our experience here definitely proved to us that the regular supervisors are the only ones who can successfully carry any training program to the men, and if they fail the job just can't be done.

Well, we had this big pow-wow in January, 1939. Following is a month by month record for 1939.

1939 Lost Time Accident Record

	Jan.	*Feb.*	*Mar.*	*Apr.*	*May*	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*	*Total*
Lost Time	3						2			4	2		11
Fatalities							2		1	1			4
Total	3						4		1	5	2		15

One of the January lost time accidents occurred while we were in session. Notice that after the conference the Department went along for 5 months without a lost time accident. Never before had we made such a record, and everyone went around patting himself on the back.

Then BANG! Two fatalities and 2 lost time accidents in July. I helped at trying to resuscitate one of the victims—a fine young apprentice lineman, high school football player, popular, good looking, good worker. It seemed like the bottom had dropped out, and we got together and talked it over. Some of the general supervisors felt we were stressing safety too much; they thought some of the men were becoming jittery. Others felt we hadn't yet got the real idea across to the man on the job. It surely seemed that the whole program had collapsed and we all felt sick about it. We just couldn't figure out what was wrong. We felt sicker as the next 3 months rolled around and we had 2 more fatalities and 6 more lost time accidents. Something was wrong, but the problem was to locate the trouble.

We reviewed every bit of the program, and it still seemed 100% right. The next step was to check how it was being put into effect. A trip was made to each division for a meeting with the foremen, the men who really do the work of supervising the job. Somehow *these* men had either not been sold or they hadn't passed it on to their men. We talked to each other like "Dutch Uncles," and some of the things we said hurt. They had to hurt. We were proving ourselves failures and we just couldn't admit we weren't equal to the task. One thing impressed me, and that was the difference between foremen in their readiness to accept full responsibility for their work and its results. Was it possible that here was the key? At any rate I started pounding away on that theme. We didn't try to soft-pedal the responsibilities for the situation. Anyway we all got steamed up and started out again to see what we could do. Our theme for the renewed effort was the responsibilities each man must carry for his work and the work of the men reporting to him. Please note that this is the only new feature we put in the program—emphasis on the responsibility angle.

The next 2 years' record speak for themselves. We are showing the years 1937 to 1941 inclusive all at one time, in order to give you the complete picture.

Five Year Accident Record

	1937	*1938*	*1939*	*1940*	*1941*
Number of Employees	609	631	566	597	793
Exposure Hours	1,135,000	1,177,609	1,130,266	1,067,925	1,484,037
Minor Accidents	59	64	40	39	60
Lost Time Accidents	57	36	11	12	9
Fatalities	3	4	4	0	0
Total Accidents	119	104	55	51	69
Frequency Rating (Total Accidents)	105.	88.4	48.6	47.7	47.
Frequency Rating (Lost Time Accident)	52.86	33.9	13.2	11.22	6.
Severity Ratings	18.	21.	21.48	.333	.176

To say we are all delighted with the improvement is an extremely mild way to put it. We are not so crazy as to not realize that once in a while something will happen and some one will get hurt. It will most probably be some very foolish accident, one that certainly could have been prevented, but as long as we are human and have all the weaknesses of human beings we will fail once in a while. We are sure, however, that the frequency of such failures can be reduced, and we feel we have done it.

This program so far has no revolutionary ideas, and in fact everything we have in our program is a part of most companies' programs. We have been asked many times, what is the real cause for the results obtained? It hasn't been easy for us to analyze our own program to say what in particular is to be credited with this improvement. There are several things, of course, that contribute to the job, and here is how we analyze the program.

1. We have good, sound safety rules and instructions. We spent 7 years developing them and they have not been changed to any extent for 3 years. However, most companies have similar rules and instructions. We are proud of ours, and no doubt you are of yours. I will be glad to send anyone a copy of these, but of course they apply more to the electric utility field. The basic principles of good workmanship are similar throughout all industries, and perhaps some of the ideas we have embodied in our instructions could be helpful to any public utility activity.

2. We *enforce* our rules. We don't have a lot of rules, just what we think are necessary, but we do enforce them. I feel quite sure a lot of companies do *not* do this. Think it over carefully before you answer for your company. Most company safety books I have looked at have so many *rules* and *orders* that you would sometimes wonder how a foreman could conscientiously enforce all of them right to the letter. Remember, I say "rules" and "orders," as differentiated from "instructions" or "suggestions." In our book there are only 4 safety rules, although possibly the rules on switching and tagging instructions should be considered in the same category. All of the rest are suggested working practices, which are merely an aid to the men.

3. We keep eternally and continuously at the job of teaching the men to follow the principles of good workmanship. Our instructions (the same as yours), are nothing but common sense applied to working condi-

tions and problems, but we are not all gifted with the ability to think in terms of good common sense all the time. We preach in every way possible, "Do the job as well as you know how." If a man does this he almost invariably does it efficiently and safely. Accident prevention is made a part of each job. A good job is always a safe job, but it could be safe and still not be good.

We don't call attention to the book of instructions as the reason for doing a thing a certain way. We merely keep at the task of instructing in better and more efficient ways to do each job. This is nothing new, of course, but we keep at it. Maybe that is our only variation.

4. We FIX RESPONSIBILITIES. And here let me say that, in my opinion, this is the keynote, if there is any keynote, to this talk. Let me repeat—*WE FIX RESPONSIBILITIES*, and we have tried to start at the *top*. Again you will say, "There is nothing new in that." Sure, there isn't. But have you ever stopped to think through what it means to fix responsibilities? If you have, no doubt you were appalled at the aspect of the load each of us must assume. I know we were in our company.

Getting right down to the specific application of this principle, we take each accident, minor as well as lost time, and attempt to fix the responsibilities for it. It is highly illuminating and nearly always a little embarrassing. The man who has the accident states his opinion as to the reason why the accident happened. His immediate supervisor states his opinion, and the general supervisor states his opinion. These are all written on the back of the report and circulated to all divisions for discussion at foremen's meetings. We have learned through experience how to avoid the personal note in these discussions. The case is analyzed as an abstract problem, and we try to learn all we can from it. Let me make a suggestion: Go back to your own job, take a dozen of the last accident reports, get two or three other supervisors in to help, and chase those accidents back to their real causes. I don't mean the sort of analysis that the accident statistical forms prescribe, or anything of a cut and dried procedure to make each accident fit into some pigeonhole with a proper label. I mean really go all the way back to real causes. It will be very enlightening research. It certainly opened our eyes.

Here is an illustration taken from our experience. In 1940 one of our divisions with about 20% of the total Operations Department personnel had over 80% of all the lost time accidents. This was hard to understand because the division had as good foremen as any of the other divisions, and it had an unusually capable general supervisor. He knew his work thoroughly, had a fine personality, every one liked him, his men were crazy about him, and in general you would think if there was any place where an accident prevention program would "click," it would be in that division. But it wasn't clicking, so we had to find out why all the other 6 divisions could get results and this one couldn't. We reviewed the last year's accident reports and came to the conclusion that the general supervisor liked his men so well he couldn't spank them when they needed it. All through his reports there ran the constant theme that something besides himself, his foremen or his men was responsible for each of his accidents. He didn't know that he was doing this. His foremen felt the same way he did because he had trained them, but they weren't aware of it either. They were conscientious, loyal men, anxious and willing to do anything necessary to get good results. They all knew their record was bad.

We arranged a meeting with the supervisory group in November, 1940. Without mincing any words we laid the situation in front of them. Then we began to go over the accident reports. No one was permitted to dodge his proper responsibilities, and before the meeting was over those men were red-hot. At the time they thought we were too critical, but they were told we were merely trying to make up for a whole year of buck-passing. They got the point, and do you know from that day to this, over 16 months, that division hasn't had a lost time accident? Same men, same tools, same work, same training—what caused the change? I feel absolutely that only one thing did it. Those foremen for the first time *felt* their responsibilities, and in turn were able to sell the men under them on *their* responsibilities. NOTHING BUT THAT.

Let me cite you another example of what I mean by fixing responsibility. In the November, 1941, issue of *Electric Light & Power*, Mr. G. G. Grieve, Statistician for the National Safety Council, wrote a fine article on "Cover Wires and Save Linemen's Lives." In this article he told of a fatality in the following words:

> "A foreman told an experienced lineman to wear his rubber gloves. The lineman angrily replied that he could do the job without them. In a few minutes he slumped in his safety belt and died before he could be resuscitated."

Men, who or what would you say was responsible for that man's death? Was the lineman responsible? In my opinion, only very slightly. What sort of training had the lineman been given that would induce him to feel he could talk back to his foreman and disobey him? What kind of a foreman was it who would permit a man to continue working unsafely after telling him what to do? What sort of a company was it that would permit such a situation to develop and not have instructed the men and supervisors what was expected of them? I tell you it was *negligence* on the part of the *top supervisory force* of that company that was responsible for that lineman's death! I don't know what company it was, and I don't want to know. But I do know this: A critical analysis of that one accident and an honest fixing of responsibility should have resulted in a complete revamping of the entire program of employee training and instruction of that company. Don't you agree with me? Think of the ramifications of such an inquiry! And don't you think such an inquiry should have been made?

You don't have to take fatal accidents for this type of analysis. You can get almost as much good out of the less serious accidents. Nearly every company, and certainly each department or division of the company will find that they are having more accidents of one particular type than any other. Pick out some reports of the accidents of the type you are experiencing most frequently, and give them a critical analysis of the type just described. Maybe you have done this, but it is my suggestion that you repeat the job and really get back to the causes of the trouble. Unless you are completely satisfied with your accident record, try out this plan and see what it does to your ideas about causes of accidents and what or who is responsible.

It will do no good to figure out responsibilities unless you do something about it. One good idea or program vigorously carried out is worth a thousand on paper. It is necessary to develop training and instruction programs to correct any lack of instruction or understanding on the part of the workmen and supervisors as to just what they should do. One of our most interesting discoveries (at least it was a discovery on our part) was that practically every man in the department knew how to do his job better than he was doing it. About all we had to do was sell him that he should do it the best he knew how. I know what you are thinking—that selling a job is the tough end of it. All I can say is that we think we have begun to solve the problem by first giving the men instructions they can respect and then fixing responsibilities. Let them help you fix the responsibilities. They can do it with a little guidance and when they have done so, they will be sold. Try it if your record is not what you think it should be.

McGraw prize paper

The Sequence Relay

A Device to Provide Short-Time System Separation on Long Period Oscillations

By Charles Lancaster Betts, Jr.

AUTHOR'S NOTE: For the past six or seven years, the Westchester Lighting Company has been trying to devise a relay scheme to afford system protection during out-of-step disturbances. Various schemes have been presented, consisting primarily of a combination of blocking and totalizing overcurrent relays, but, as these all employed ordinary induction-type devices, the operating time was so slow that ordinary feeder-protection relays would function ahead of the out-of-step relay.

Although there are several out-of-step relays on the market, they are likewise too slow in their operation for use on the Westchester system. They consist, in general, of a duo-directional overcurrent relay and a notching relay which require three and one-half slip cycles to complete the trip circuit. To be effective on the Westchester system, an out-of-step relay must complete the trip circuit in less than one-half of the first slip cycle.

The purpose of this paper is to describe the design, development and application of a short-time out-of-step relay suitable for providing system separation upon the occurrence of long period oscillations. Although the scheme described in the text outlines the installation of three such devices for the Westchester system, only one is being installed at present, due to extensive changes contemplated in transmission and distribution facilities which may necessitate a change in normal operating practices.

The writing of this paper would have been impossible without many preliminary tests and studies requiring the full cooperation of the Electric Test Department of the Westchester Lighting Company; especially Messrs. W. Jordan, N. Lindsay, W. VanTassell, R. Giani and H. McTeer, to whom the author is deeply indebted. In addition, he wishes to express his appreciation to Mr. Albert Alberi of the Legal Department, Westchester Lighting Company, for his kindness in reading the text, and to Messrs. Lindamuth and Brodsky of the Consolidated Edison Company of New York, and to Mr. A. C. Sugden of the General Electric Company, New York, for their assistance in the development of the sequence relay.

THE interconnection of the power generating sources of two large systems by means of high-capacity, high-voltage transmission lines facilitates reliable and economical electric power distribution. This is especially true in cases where one system consists primarily by hydro generating stations and the other primarily of steam generating stations. At times when there is a large amount of hydro power available, the steam stations can shut down partially for annual repairs and reconditioning, whereas when there is only a limited amount of hydro power available, the steam stations can carry the major portion of the load.

MR. BETTS

Mr. Betts is the winner of the second James H. McGraw Prize for 1942. He has the distinction also of winning the second McGraw prize in 1940 and a H. M. Byllesby Accounting Award in 1936.

Mr. Betts was graduated from Rensselaer Polytechnic Institute as mechanical engineer in 1933 and also attended Rider Business College, Trenton, N. J., during 1934. He was employed by M. R. Scharff, New York, in connection with the inventory and appraisal of Westchester Lighting Company's properties from 1934 to 1935. On the completion of this work he was transferred to the company's Continuing Property Record Department. In 1937 he was employed in the Electric Test Department and later was made Relay Engineer. Mr. Betts recently left the employ of the Westchester Lighting Company to go into defense work.

The Consolidated Edison Company is a steam generating system located in New York City, whereas the Niagara-Hudson Corporation is primarily a hydro generating system located in upper New York State. The interchange of power between these two large systems is accomplished by two parallel 132-kv transmission lines extending through Westchester County, New York. These lines are the property of the Westchester Lighting Company, with connections at its Millwood substation to the Niagara-Hudson system, and at its Dunwoodie substation to the Consolidated Edison system. In addition to providing means for interchanging power between these two systems, these two 132-kv feeders are tapped to supply the entire load of Westchester County at three substations: Millwood, Dunwoodie and Elmsford (the latter being approximately the mid-point between Millwood and Dunwoodie).

The Westchester Lighting Company serves Westchester County by means of 15 substations, all of which are interconnected by low-voltage ties. Some of these low-voltage ties parallel the two 132-kv transmission feeders and are shown in a simplified one-line diagram in Fig 1. This illustration shows (1) that in addition to the 132-kv feeders 9823 and 9824 between Millwood and Elmsford there is a parallel low-voltage (13-kv) tie through Ossining and Tarrytown; (2) that in addition to the 132-kv feeders 9821 and 9822 between Elmsford and Dunwoodie there is a parallel low-voltage (45-kv and 13-kv) tie through White Plains, Mamaroneck and New Rochelle; and finally (3) that in addition to the 132-kv feeders 9955 and 9956 between Dunwoodie and the Consolidated Edison system, there is a parallel low-voltage (45-kv and 13-kv) tie through New Rochelle.

Factors Governing System Separation

Whenever any pair of 132-kv feeders are out of service between two successive substations, such as Fdrs. 9823 and 9824 between Elmsford and Millwood (see Fig. 1, A-B), Fdrs. 9821 and 9822 between Elmsford and Dunwoodie (see Fig. 1, C-D), Fdrs. 9821, 9822, 9823 and 9824 between Dunwoodie and Millwood (see Fig. 1, A-D), or Fdrs. 9955 and 9956 between the Consolidated Edison system and Dunwoodie (see Fig. 1,

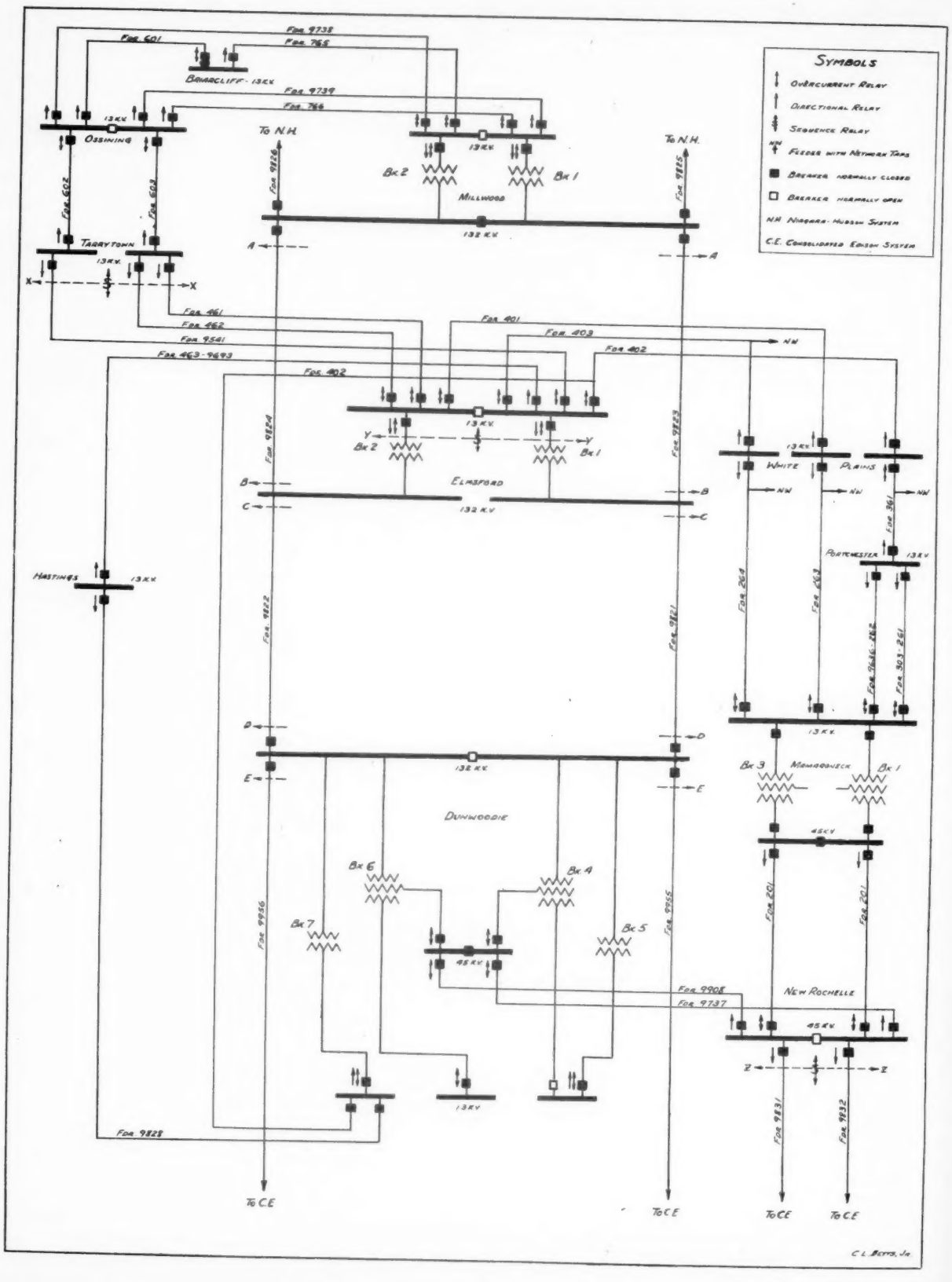

Fig. 1—Condensed One-Line Diagram

E), an out-of-step condition between the generators on the Consolidated Edison system and those on the Niagara-Hudson system will cause large currents to flow through the interconnecting 13-kv and 45-kv feeders of the Westchester Lighting Company's distribution system. These currents will be of sufficient magnitude to cause overcurrent directional relays on certain 13-kv and 45-kv feeders to operate at widely separated substations, depending on which pair of 132-kv feeders happen to be out of service during the out-of-step condition. In addition to impairing the supply to these substations, some of the 13-kv feeders supply network grids, and, if these feeders should open up at one end due to out-of-step current, the two systems would be tied together through the network until such time as either the network protectors opened or fuses blew.

In order to provide a reliable and adequate source of supply to all substations, and in order to obviate the possibility of the Consolidated Edison and the Niagara-Hudson systems being tied together through a network under out-of-step conditions, a relay scheme has been devised to definitely separate the two systems at certain predetermined locations. A study was made to determine at what locations it would be most desirable to separate the two systems from the standpoint of:

1. Reliable and adequate supply to all substations;
2. Continuity of service to the networks; and
3. Maximum current arising from an out-of-step condition.

The following conclusions resulted:

1. When Fdrs. 9823 and 9824 are out of service between Millwood and Elmsford (A-B, Fig. 1), the two systems should be separated by opening Fdrs. 9541, 461 and 462 at Tarrytown (X, Fig. 1).
2. When Fdrs. 9821 and 9822 are out of service between Elmsford and Dunwoodie (C-D, Fig. 1), the two systems should be separated first by opening the 13-kv side of Banks No. 1 and No. 2 at Elmsford (Y, Fig. 1) and secondly by opening Fdrs. 9541, 461 and 462 at Tarrytown (X, Fig. 1).
3. When Fdrs. 9821, 9822, 9823 and 9824 are out of service between Millwood and Dunwoodie (A-D, Fig. 1), the two systems should be separated by opening Fdrs. 9541, 461 and 462 at Tarrytown (X, Fig. 1).
4. When Fdrs. 9955 and 9956 are out of service between Dunwoodie and the Consolidated-Edison system (E, Fig. 1), the two systems should be separated by opening Fdrs. 9831 and 9832 at New Rochelle (Z, Fig. 1).

From the foregoing it can be seen that some means must be provided to separate the two systems at each of the three locations mentioned; namely, Tarrytown, Elmsford and New Rochelle, under various out-of-step conditions.

As the currents flowing over the various feeders and banks mentioned above vary widely at each location during an out-of-step condition, it was decided to parallel current transformers on certain feeders and banks at the three locations. This will reduce the number of protective relays required to one set of out-of-step relays at each of the three locations. Thus it was possible to deal with the summation currents over the feeders or banks in question and also obviated the necessity for determining individual relay settings for each feeder or bank included above. There are several other reasons for paralleling the current transformers and using only one set of out-of-step relays at each location:

1. Less cost for equipment.
2. Less cost for installing equipment.
3. Less cost for maintaining and testing equipment.
4. Less board space required.
5. This arrangement will provide the same protection even if the associate feeder (or bank) is out of service at the occurrence of an out-of-step condition.

Although there are no actual oscillograms available for out-of-step conditions on the Westchester system, it can be assumed that the swing oscillations will be rather slow, probably not faster than ¾ second. This is considered to be a reasonable and conservative assumption in view of the size of the two generating systems which it connects.

The initial direction of flow of fault current will depend on the location of the fault; thus when the disturbance or fault causing the out-of-step condition occurs on the Niagara-Hudson system, the current flow will be toward the Niagara-Hudson system; and the reverse will be true for trouble on the Consolidated Edison system. Bearing this in mind, it is evident that the directional relays at the three separating points must be given special consideration. The pick-up of all these directional relays is below the maximum out-of-step current under various conditions, so that when the current is in the right direction with respect to an individual directional relay, this relay will operate to clear the feeder or bank. As an illustration, it will be assumed that feeders 9821 and 9822 are out of service and the direction of flow of current is toward the Niagara-Hudson system; remembering that under this condition it is desired to separate the two systems (1) by opening the 13-kv side of Banks No. 1 and No. 2 at Elmsford (Y, Fig. 1) and (2) by opening feeders 9541, 461 and 462 at Tarrytown (X, Fig. 1), it is apparent that the current will be in the right direction to operate the directional relays on Banks No. 1 and No. 2 at Elmsford, but in the wrong direction as far as the directional relays on Fdrs. 9541, 461 and 462 at Tarrytown are concerned; instead the current will be in the right direction to operate the directional relays on Fdrs. 602 and 603 at Tarrytown, which is an undesirable operation. In view of this fact, it becomes imperative to adopt a positive means for separating the two systems at exactly the points desired, irrespective of the direction of current flow during the out-of-step condition.

Analysis of Out-of-Step Condition

Before going into a detailed discussion of the actual relay scheme to provide positive and definite separation under out-of-step conditions, however, a brief explanation will be given regarding the nature of out-of-step currents. The Westchester system can be considered as furnishing the transmission line between two groups of generators (i. e., between the generators of the Niagara-Hudson system on the north and the generators of the Consolidated Edison system on the south). If a fault should occur in some generator or near either group of generators (but outside the Westchester system), the generators comprising one group will fall out of synchronism with those comprising the other group, that is if the fault is not immediately cleared.

For the sake of simplicity, the generators of the Niagara-Hudson system can be thought of as a single large machine, called the north generator; likewise those of the Consolidated Edison system can be thought of as a single large machine, called the south generator. When two such generators fall out-of-step, the poles of one generator will advance at a faster rate than those of the other; this is known as "pole slip." When the poles of one generator have slipped through an angle of 360° with respect to the poles of the other generator, one "slip cycle" will have occurred. At that instant the two generators will be back in step again. If the fault has not been removed during the first slip cycle, or if the two generators have not been separated during this interval, a second slip cycle will occur, but this will take a longer period of time than the first. This is true because the second (or remote) generator will now feel the effects of the fault on or near the first (or faulted) generator, so that it will tend to slow down and keep its

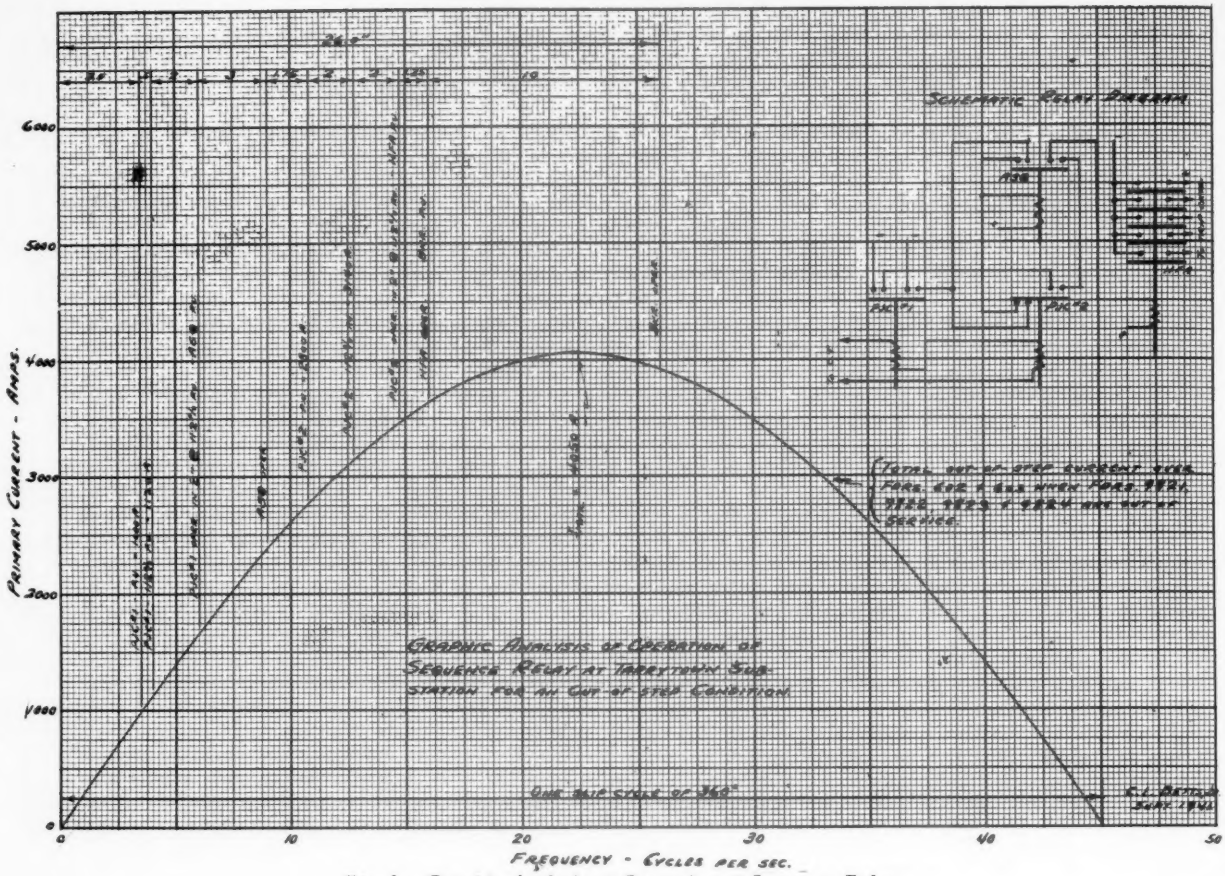

Fig. 2—Graphic Analysis of Operation of Sequence Relay

poles in step with those of the first generator.

Returning again to the first slip cycle, it can be assumed that there will be no potential difference between the two generators just an instant before the occurrence of an out-of-step condition. Hence there will be zero current flow between the two generators because the voltages will be in phase and of the same magnitude. As the fault causes one generator to slow down, and as the poles of the two machines continue to slip with respect to each other, the voltage difference will increase to a maximum value when the poles have slipped through 180°, and then will decrease to zero as the poles continue to slip through one slip cycle of 360°, or when the two generators have come back in step. The resultant current behaves in the same manner as the voltage difference; that is, when the voltage difference is zero at the start and finish of the slip cycle, the resultant current will also be zero; and when the voltage difference reaches a maximum value at 180° pole slip, the resultant current will also reach a maximum value. In order to avoid confusion, the angle in degrees will always be referred to the pole slip, because a complete slip cycle of 360° of the poles produces a shift in phase of the resultant current of only 180°.

From this brief elementary discussion, it can be concluded that the resultant flow of current between two systems which are out-of-step is not in the form of a full sine wave but is only one-half of a sine curve which varies from zero to zero through 180° during one complete slip cycle of 360°.

Assuming the first slip cycle of 360° to take place in ¾ second (or in 45 current cycles on a system which has a normal frequency of 60 cycles per second), the current will not reach its maximum value until the poles have slipped 180°, which will require $\frac{1}{2} \times \frac{3}{4} = \frac{3}{8}$ second or 22.5 current cycles. On the other hand, during a three-phase fault the current will reach its maximum value in a relatively short time, 0.25 to 0.50 current cycle.

The Sequence Relay

Advantage is taken of this difference in the "rate of rise" of current in order to distinguish between an out-of-step condition and a three-phase fault. In order for a relay to be able to differentiate between these two contingencies so that it would operate (1) to trip on an out-of-step condition, and (2) to prevent tripping on a three-phase fault, the development of such a protective device was based on a different sequence of events occurring in various units comprising the complete relay depending on this "rate of rise" of current. This complete relay, made up of several types of individual relays, or units, that operate in sequence, is therefore called a "sequence relay."

The three-phase sequence relay, designed to provide system separation on out-of-step conditions, consists of the following units:

On A-phase

1. A high-speed plunger type relay set to pick-up at a current value approximately 100 amperes above the maximum load current which can be supplied by the feeders or banks to which the sequence relay is connected. The General Electric relay, type PJC, having two sets of normally open contacts which control two independent circuits, was found to be satisfactory. This unit will be designated as "PJC No. 1."

2. A second high-speed plunger type relay set to pick-up at a current value between two and three times the pick-up of PJC No. 1, but not higher than 85% of the maximum out-of-step current. The General Electric relay, type PJC, is also well suited for this application, but in this case the contact arrangement must be such that one set is normally closed and one set normally open. This unit will be designated as "PJC No. 2."

On B- and C-phases

On each phase (B and C), a General Electric relay, type PJC, designated as "PJC No. 2," similar to that listed for A-phase, item (2) above, and with the same setting.

DC Relays

1. An auxiliary, plunger type relay commonly used in telephone applications, controlling two independent circuits with two sets of normally open contacts, set to operate in 3 cycles when the full operating voltage is impressed across its operating coil. The Automatic Electric relay, type ASO, is well suited for this application. This unit will be designated as "ASO."

2. An auxiliary, clapper type, high-speed relay providing sufficient normally independent circuits to trip all the breakers at a particular location for system separation. The General Electric relay, type HFA, is satisfactory for this application. This unit will be designated as "HFA."

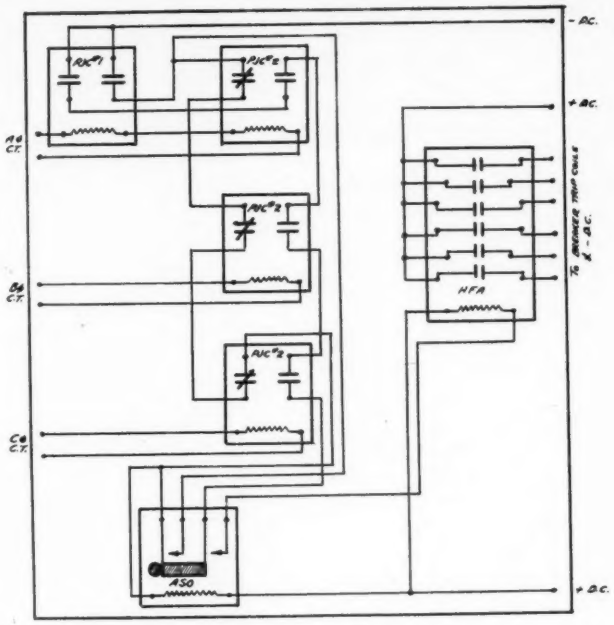

Fig. 3—Schematic Wiring Diagram Three-Phase Sequence Relay

Preliminary Tests

In order to determine the operating characteristics of the various units mentioned above, one PJC No. 1, one PJC No. 2 and one ASO unit were purchased and tested in the laboratory of the Westchester Lighting Company. After having checked the operating times of the PJC No. 1 and PJC No. 2 units to make sure that they would operate in two cycles at 112 per cent pick-up setting, they were connected, along with the ASO unit, as shown in the diagram in Fig. 2. Then a current was applied, simulating an out-of-step condition, which varied from zero to a maximum value of 1.20 times pick-up setting on the PJC No. 2 unit and back to zero again in 45 current cycles; under this test the various units operated in the proper sequence to complete the trip circuit. The second test consisted of instantly applying a current of 1.20 times the PJC No. 2 pick-up setting to the units in order to simulate a three-phase fault condition; this showed that the trip circuit would not be completed due to the fact that the ASO unit did not close its contacts.

Operation of Sequence Relay for Out-of-Step Condition

The arrangement and schematic wiring diagram for the complete, three-phase sequence relay, comprised of all the relays mentioned above, is shown in Fig. 3. The operation of this sequence relay can be illustrated most readily by taking a typical out-of-step condition when it is desired to separate the system by opening Fdrs. 9541, 461 and 462 at Tarrytown when Fdrs. 9821, 9822, 9823 and 9824 are out of service between Dunwoodie and Millwood.

Referring to Fig. 2, the resultant current is plotted for the full slip cycle of 360° taking place in 45 current cycles, with "Cycles" as the abscissa and "Current" as the ordinate. This curve represents the summation of the out-of-step current over Fdrs. 602 and 603 at Tarrytown with Fdrs. 9821, 9822, 9823 and 9824 out of service, and thus is the value of current affecting the sequence relay, connected to the current transformers on Fdrs. 602 and 603 at Tarrytown which are connected in parallel, to trip the breakers on Fdrs. 9541, 461 and 462 at Tarrytown.

It will be observed that when the slip cycle has progressed through 3.5 current cycles, the current has reached a value of 1000 amp. This is the value at which the first overcurrent relay, known as PJC No. 1, is set to pick-up. This relay will be adjusted to close its two sets of normally open contacts in two cycles when the current has reached 112 per cent of the pick-up value. The current will rise to 1120 amp (112 per cent of 1000 amp) 0.5 cycle after the PJC No. 1 first starts to pick-up, so that it will close its contacts 2.5 cycles after the relay starts to pick-up. This will mean that the slip cycle has advanced through 3.5 plus 2.5 or 6 current cycles. As soon as the PJC No. 1 relay has closed its contacts, the DC relay, known as ASO, will be energized through the normally closed contacts of the second overcurrent relay, known as PJC No. 2. The ASO relay will be adjusted to provide a delay of three cycles before it closes its contacts; thus the ASO will not close its contacts until the slip cycle has progressed through 6 plus 3 or 9 current cycles. The ASO relay seals itself in as soon as its contacts are closed and will remain sealed in as long as the PJC No. 1 relay contacts are closed. During the following 1.75 cycles (or from 9 to 10.75 cycles) the out-of-step current is rising to a value of 2800 amp. The PJC No. 2 is set to pick-up at this value, and it will take two cycles for the current to build up to 3140 amp (112 per cent of 2800 amp) and an additional two cycles for the PJC No. 2 to close its normally open contacts, the total elapsed time from the beginning of the slip cycle being 10.75 plus 2 plus 2 or 14.75 current cycles. When the PJC No. 2 has closed its normally open contacts, the current to the operating coil of the HFA auxiliary relay has been completed. As the HFA relay requires 1.25 cycles to operate and close its contacts, the total elapsed time from the start of the slip cycle will be 14.75 plus 1.25 or 16 current cycles. The trip circuit to the breakers on the feeders will be completed as soon as the HFA has closed its contacts, so that the system will be sep-

arated in the additional time required for the breakers to operate (8 to 12 cycles) which will be 16 plus 8 (or plus 12) equals 24 (or 28) current cycles as the time required from the origin of the slip cycle or out-of-step condition.

The foregoing analysis explains only the operation of the sequence relay at Tarrytown under one particular out-of-step condition. It is presented merely as a general illustration of the time required by the different units of the sequence relay to function; the sequence relays at Elmsford and at New Rochelle operate in a similar manner. Although curves have been worked out for the other out-of-step conditions for the sequence relays at Elmsford and New Rochelle, they have not been included here; instead Table II is offered as a ready means for comparing the operation of the sequence relays at each location for different out-of-step conditions. For instance, under out-of-step condition No. 1, the system will be separated by the opening of Fdrs. 9541, 461 and 462 at Tarrytown in 26 current cycles due to the operation of the sequence relay at Tarrytown in 16 current cycles; the sequence relays at Elmsford and at New Rochelle will not operate under condition No. 1.

Under out-of-step condition No. 2, it will be necessary to open Banks No. 1 and No. 2 at Elmsford in addition to Fdrs. 9541, 461 and 462 at Tarrytown in order to separate the system. It will be noted from Table II that Banks No. 1 and No. 2 will open at Elmsford in 28 cycles, but the system will not be separated until after Fdrs. 9541, 461 and 462 have opened at Tarrytown in 41.25 cycles. The remaining two out-of-step conditions are almost self-explanatory; in condition No. 3 it is seen that the system will be separated at Tarrytown in 23 cycles, and in condition No. 4 the system will be separated at New Rochelle in 31.75 cycles.

The small schematic wiring diagram in the upper right hand corner of Fig. 2 illustrates the operating principle of the combination of relay units comprising the sequence relay to provide out-of-step protection. Certain modifications have been included in the final three-phase wiring diagram as shown in Fig. 3; this shows that only one PJC No. 1, one ASO and one HFA relay is required for the three-phase set, but that one PJC No. 2 is required for each phase. Therefore the complete three-phase sequence relay to separate the system by opening Fdrs. 9541, 461 and 462 at Tarrytown will consist of the following units, with respective settings on each:

1—PJC No. 1; 1000 amp pick-up
3—PJC No. 2; 2800 amp pick-up
1—ASO; 3 cycles delay
1—HFA auxiliary

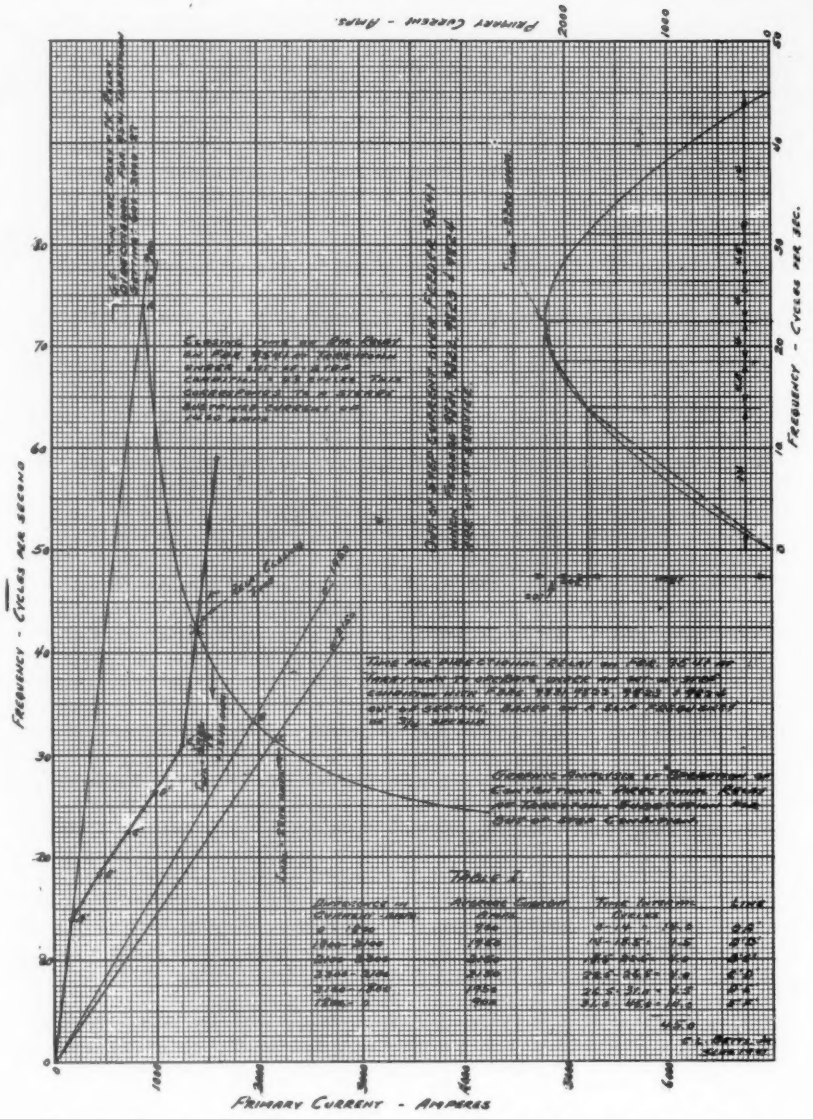

Fig. 4—Graphic Analysis of Operation of Conventional Directional Relay

Considering a three-phase fault on Fdr. 9541 at Tarrytown, the sequence relay will receive the sum of the currents flowing over Fdrs. 602 and 603 (2750 plus 100 amp) or 2850 amp. Although a three-phase fault on Fdr. 9541 at Tarrytown will cause 3750 amp to flow into Fdr. 9541, the effect on the sequence relay will be only 2850 amp. As pointed out previously, the current builds up to this value of 2850 amp very rapidly (0.25 to 0.5 cycle) as compared to the time required to reach the maximum value during an out-of-step condition (22.5 cycles for 3.4 second slip cycle).

TABLE I.

Difference in Current, Amps	*Average Current, Amps*	*Time Interval, Cycles*	*Line*
0-1800	900	0 -14 = 14.0	O' A'
1800-2100	1950	14 -18.5 = 4.5	A' B'
2100-2200	2150	18.5-22.5 = 4.0	B' C'
2200-2100	2150	22.5-26.5 = 4.0	C' D'
2100-1800	1950	26.5-31.0 = 4.5	D' E'
1800-0	900	31.0-45.0 = 14.0	E' F'
		45.0	

Operation of Sequence Relay for Three-Phase Fault

It is now possible to analyze the action of the out-of-step, or sequence, relay during a three-phase fault where the

TABLE II—ANALYSIS OF SEQUENCE RELAY OPERATIONS

Out-of-step Condition No. 1—Fdrs. 9821, -2, -3 & -4 out:
Sequence relay at Tarrytown: operates in 16.0 cycles.
Sequence relay at Elmsford: will receive no current.
Sequence relay at New Rochelle: will not pick-up.
Out-of-step Condition No. 2—Fdrs. 9821 & -2 out:
Sequence relay at Tarrytown: operates in 31.25 cycles.
Sequence relay at Elmsford: operates in 18.0 cycles.
Sequence relay at New Rochelle: will not pick-up.
Out-of-step Condition No. 3—Fdrs. 9823 & -4 out:
Sequence relay at Tarrytown: operates in 13.0 cycles.
Sequence relay at Elmsford: system will separate before Elmsford banks open.
Sequence relay at New Rochelle: will not pick-up.
Out-of-step Condition No. 4—Fdrs. 9955 & -6 out:
Sequence relay at Tarrytown: will not pick-up.
Sequence relay at Elmsford: will not pick-up.
Sequence relay at New Rochelle: operates in 21.75 cycles.
This schedule is based on a slip cycle (360°) of ¾ second.

The operating times indicated above are the overall times required by the combination of relays, called "sequence relay," to complete the trip circuit to the breaker and is calculated from the start of the slip cycle. Add 8 to 12 cycles (average 10 cycles) for the breakers to clear the feeders or banks.

This schedule is based upon the following relay settings:
At Elmsford
PJC No. 1—2000 amps pick-up
PJC No. 2—4000 amps pick-up
At Tarrytown
PJC No. 1—1000 amps pick-up
PJC No. 2—2800 amps pick-up
At New Rochelle
PJC No. 1—1000 amps pick-up
PJC No. 2—2000 amps pick-up

current will rise to 2850 amp in less than one cycle. As the PJC No. 1 is set to pick-up at 1000 amp, it will receive 2850/1000 × 100 per cent or 285 per cent pick-up current, which will require about 0.75 cycle to close its contacts. As soon as the PJC No. 1 closes its contacts, the ASO will be energized provided the PJC No. 2 does not pick-up (that is, as long as the normally closed contacts of the PJC No. 2 remain in the closed position). The ASO will not operate until an interval of 3 cycles has elapsed, with the PJC No. 2 remaining in its de-energized position. But the PJC No. 2 is set to pick-up at 2800 amp, and as it will receive a value of 2850 amp within 0.75 cycle after the origin of the fault, the PJC No. 2 will start to pick-up without any intervening time delay. This means that the normally closed contacts of the PJC No. 2 unit will open before the ASO has had its necessary three cycles to operate, thereby opening the operating circuit to the ASO and causing it to drop-out. Thus it is evident that the out-of-step relay will not operate the HFA or tripping unit. Although the PJC No. 1 and the PJC No. 2 units will have operated for a three-phase fault on Fdr. 9541 at Tarrytown, the ASO will not operate, which in turn will prevent the tripping of the breakers as far as the out-of-step relay is concerned; only the directional relay on Fdr. 9541 will operate to trip the breaker on Fdr. 9541 at Tarrytown.

Behavior of Conventional Relays

The next point to be considered is the behavior of the ordinary induction type relays under out-of-step conditions. The relay curves supplied by the manufacturers indicate the operating time at various values of steady, sustained current. For instance, taking the curve for the directional relay on Fdr. 9541 at Tarrytown; referred to primary current, it is set to pick-up at 600 amp and to close its contacts in 27 cycles when the feeder supplies a steady, sustained current of 3000 amp for the full 27 cycles. This curve is shown in Fig. 4 plotted for all values of steady, sustained primary current from 900 amp to 4000 amp.

Considering the out-of-step condition previously referred to when Fdrs. 9821, 9822, 9823 and 9824 are out of service, and assuming the flow of power to be toward the Consolidated Edison system, a slip cycle of ¾ second will cause a maximum current of 2200 amp to flow in Fdr. 9541 in the right direction to operate the directional relay on this feeder at Tarrytown. Referring to Fig. 4, it is seen that if a steady, sustained current of 2200 amp were applied to this relay it would operate in 31 cycles. But this value of 2200 amp is a maximum out-of-step current, which, on a ¾ second slip cycle, will not be attained until the first half of the slip cycle has been reached, or until an interval of 22.5 cycles has elapsed.

An analysis of the curve representing the change in the magnitude of current on Fdr. 9541 for the out-of-step condition is also shown in Fig. 4. It is apparent that this curve can be approximated by a series of straight lines, the first straight line being from 0 to 1800 amp, the second from 1800 to 2100 amp and the third from 2100 to 2200 amp. It is also seen that it will take 14 cycles for the current to increase from 0 to 1800 amp; it will take an additional 4.5 cycles for it to increase from 1800 to 2100 amp, and finally it will take an additional four cycles for it to increase from 2100 to 2200 amp, or to reach the maximum value. Then the current can be considered to decrease from 2200 to 0 amp in three steps in similar time intervals for the second half of the slip cycle.

Before applying this data to the relay curve for the directional relay on Fdr. 9541 at Tarrytown (Fig. 4), it must be remembered that this curve is based on values of steady, sustained current. As the out-of-step current increases from 0 to 1800 amp in 14 cycles, the same effect, as far as the directional relay is concerned, would be obtained by a steady, sustained current of the average value of current, 1800/2 or 900 amp for a period of 14 cycles. Likewise the current rise from 1800 to 2100 amp can be considered to be the average value of current (1800 + 2100)/2 or 1950 amp, for a period of 4.5 cycles. And finally the current rise from 2100 to 2200 amp can be considered to be the average value of current (2100/2200)/2 or 2150 amp, for a period of four cycles. The data for the complete slip cycle is given in Table I, Fig. 4.

Again referring to the relay curve of Fig. 4, the line OA is drawn from the origin to the point where the relay curve crosses the line representing 900 amp. Thus the line OA represents the rate at which the relay contacts will close when a steady, sustained current is applied to the relay and indicates that they will not be fully closed until the 900 amp have been applied for 74 cycles. Other "contact closing rate" lines can be drawn for other values of steady, sustained current, such as OB for 1950 amp, and OC for 2150 amp.

Now it will be possible to make use of the data obtained in Table I in order to determine the operating time of the

directional relay on Fdr. 9541 at Tarrytown under the out-of-step condition. First the point A' is laid off, along the "contact closing rate" line OA, so that A' is opposite 14 cycles on the cycles scale. Then the point B' is found by drawing the line A'B' parallel to OB for a distance of 4.5 cycles, or until point B' is opposite 14 + 4.5 or 18.5 cycles on the cycles scale. Point C' is found in a similar manner by drawing the line B'C' parallel to OC for a distance of four cycles, or until point C' is opposite 18.5 + 4 or 22.5 cycles on the cycles scale. This procedure is followed for plotting points D', E', and F', so that the final irregular curve OA'B'C'D'E'F' represents the rate at which the contacts will close under the out-of-step condition. And the point at which this curve, OA'B'C'D'E'F', intersects the relay curve, which is at X, indicates the time required for the relay to close its contacts.

In this particular case, the point X intersects the relay curve at 1400 amp and 43 cycles. This indicates that, even though the maximum out-of-step current is 2200 amp, the equivalent steady, sustained current on the relay is only 1400 amp, or $(1400/2200) \times 100$ per cent $=$ 63.6 per cent of the maximum out-of-step current. Assuming the magnitude of the maximum out-of-step current to remain constant (namely 2200 amp), the equivalent steady, sustained current will vary slightly for different periods of oscillation of the slip cycle. For all practical purposes, however, the equivalent steady, sustained current, or "effective" current, can be considered as being approximately 70 per cent of the maximum out-of-step current.

Selectivity

This brings up an important point in the study of selectivity under out-of-step conditions between ordinary inverse-time induction relays and the special instantaneous plunger-type relays. These plunger-type relays, used for out-of-step protection, would be of no value if certain induction-type relays on the system should possess the ability to operate first. It is, therefore, necessary to investigate this condition in order the provide a margin of 20 cycles clearance between the operating times of the two different types of relays when subjected to the same disturbance. This can be shown by plotting the characteristic curves for the induction relays installed on those feeders which supply the greatest out-of-step current for the condition under consideration. In indicating the value of out-of-step current on the relay curves, it must be remembered that it is not the maximum value but the effective value that is shown in order to determine the operating time of each induction type relay.

As the out-of-step relay is in reality a combination of several different relays, and inasmuch as its operating time is a function of the period of oscillation, the rate of current rise, and the magnitude of the maximum out-of-step current, no characteristic curve can be plotted for it. Instead the operating time of the out-of-step relay must be determined separately for each particular condition, and, for purposes of comparison, it can be shown as a straight line drawn at its operating time value, parallel to the "Current" axis, so that no specific current value will be indicated.

The question as to what particular directional relays should select with the out-of-step relay depends upon the location of the disturbance causing the out-of-step condition. In considering the problem previously dealt with, namely, when Fdrs. 9821, 9822, 9823 and 9824 are out of service, if the origin of the disturbance should be on the Consolidated Edison system to the south, excessive currents would flow in Fdrs. 9541, 461 and 462 in the correct direction to operate the directional relays on these feeders at Tarrytown. Inasmuch as it is desirable to trip these feeders at this location under this condition, it matters little whether they are cleared by the directional relays or by the special out-of-step relay. From an operating standpoint, however, it would be much better to have these feeders cleared by the out-of-step relay, because then the station operator will know positively

STATION_____ TRIPS _____
SETTINGS: PJC#1_____Amps. PJC#2_____Amps.
C.T. RATIO_____to _____

CHARACTERISTIC CURVES

A Phase PJC#1			
Amps.	1st Ob.	2nd Ob.	3rd Ob.
A Phase PJC#2			
Amps.	1st Ob.	2nd Ob.	3rd Ob.
B Phase PJC#2			
Amps.	1st Ob.	2nd Ob.	3rd Ob.
C Phase PJC#2			
Amps.	1st Ob.	2nd Ob.	3rd Ob.

CONTINUITY CHECK

Connect operating coils of PJC#1 (A Phase) and all PJC#2 (A, B and C Phases) units all in series.

(1) Apply_____ amps. (1 Ø) to sequence relay:
  a) ASO unit operates?_____
  b) PJC#2 units operate?_____
(2) Increase current (1 Ø) to sequence relay so that all PJC#2 units will operate:
  c) PJC#2 units operate at_____amps.
  d) HFA unit operates?_____
(3) Remove all current applied under (1) and (2); then suddenly apply_____amps. (1 Ø) to sequence relay:
  e) Do PJC#1 and PJC#2 units all operate simultaneously?_____
  f) ASO unit operates?_____
  g) HFA unit operates?_____

Tester_____ Asst._____ Date_____
Checked by_____ Date_____

Fig. 5—Sequence Relay Test Form

that there is an out-of-step disturbance, and that under no circumstance should a reclosure be attempted until the two systems are in synchronism.

Calibration & Maintenance

The calibration of the sequence relay cannot be expressed or determined as simply as that of ordinary overcurrent and directional relays. Each individual unit must be calibrated so as to function within certain prescribed limits of current and time in order that the relay, as a whole, may operate correctly under both fault and out-of-step conditions.

The characteristics of the PJC No. 1 unit on A-phase should be checked for pick-up and for operating time at 112 per cent of pick-up current. (All references will be made to the installation of the sequence relay at Tarrytown as a typical illustration.) As the current transformer ratio at Tarrytown is 400:5, the PJC No. 1 unit should be set to pick-up at 12.5 amp secondary current (1000/400:5 = 12.5 amp) and to close its contacts in two cycles at 14.0 amp (1.12 × 12.5 amp). Likewise the PJC No. 2 units on A-, B- and C-phases should be checked for pick-up and for operating time at 112 per cent of pick-up current; all these units should be set to pick-up at 35 amp (2800/400:5 = 35 amp) and to close their normally open contacts in two cycles at 39.2 amp (1.12 × 35 amp). Care should be taken to use the set of circuit closing (normally open) contacts when timing the PJC No. 2 units, and, as far as the PJC No. 2 unit on A-phase is concerned, the test current should be applied directly to the current studs of the PJC No. 2 unit and not to the PJC No. 1 unit on A-phase, which is connected in series with the PJC No. 2 unit on A-phase.

The pick-up settings on all these units can be adjusted by turning the armature on the plunger rod; the armature is provided with an internal locking spring that requires no manipulation. As the operating coils are continuous, there are no "taps" to be changed. Due to the fact that the correct operation of the sequence relay depends entirely upon the accuracy of the settings applied to each individual unit, the importance of obtaining the settings specified cannot be over-emphasized.

As the sequence relay is a three-phase device which is designed to complete the trip circuit under out-of-step conditions, it would require a complicated procedure to test the complete relay for its operation under these conditions. In order to simplify this test, it is suggested that all the operating coils of the PJC No. 1 and the PJC No. 2 units of A-, B- and C-phases be temporarily connected in series in order that it may be tested with single-phase current. This will introduce no error because this is a "sequence" or "continuity" check and not a timing test. As soon as this check has been completed, however, the temporary series connection must be removed. The continuity check should follow the outline shown below:

1. A single-phase current, slightly above the pick-up value of the PJC No. 1 unit (18 to 25 amp, but less than 35 amp) should be applied to the sequence relay. For this test the PJC No. 1 unit and the ASO unit should operate, but all the PJC No. 2 units should remain in the de-energized position.

2. Continuing from step (1) above, the single-phase current should be increased to a value slightly above the pick-up setting of PJC No. 2 units (43 to 50 amp); now all the PJC No. 2 units and the HFA unit should operate to complete the trip circuit.

3. Next all current applied in steps (1) and (2) above should be removed. Finally a single-phase current of 150 per cent pick-up value of the PJC No. 2 units (1.5 × 35 = 52.5 amp) should be *suddenly* applied to the sequence relay. For this test the PJC No. 1 and all three PJC No. 2 units should operate simultaneously, thereby preventing the operation of the ASO and HFA units.

The foregoing pick-up, time and "continuity" tests should be made at the time the relay is installed and once per year thereafter; Fig. 5 represents a form for conveniently recording this data. In addition, the sequence relay should be inspected monthly to see that all connections are tight, that the contacts of each unit are in good condition, and that all targets operate correctly. The pick-up current on the PJC No. 1 and the PJC No. 2 units should be determined individually. The wiring should be checked by raising the plungers of the PJC No. 1 and all PJC No. 2 units by hand to see that the ASO and HFA units operate satisfactorily.

Summary

1. An out-of-step condition betwen the Niagara-Hudson and the Consolidated Edison systems will endanger the continuity of service to certain network areas and impair the supply of energy to certain substations in the Westchester system when any adjacent pair of 132 kv tie lines are out of service.

2. This danger can be obviated by providing a means for separating the Niagara-Hudson and the Consolidated Edison systems automatically in a low voltage (13 kv or 45 kv) tie upon the occurrence of an out-of-step condition.

3. The automatic means to provide this separation must be sensitive to out-of-step conditions and non-sensitive to all other types of faults.

4. System separation can be obtained by using a combination of instantaneous and definite time-delay relays, called collectively a sequence relay, which functions to trip only on a predetermined sequence of operations depending on the rate and magnitude of current rise.

5. The sequence relay is a totalizing relay; that is, it is connected to parallel-connected current transformers on the feeders or banks which are to measure the out-of-step current so that the same degree of protection will be provided even if the associated feeder (or bank) is out of service during the out-of-step condition.

6. It is assumed that the two systems will require at least ¾ second to reach 360° out-of-step condition due to the large inertia constants of the systems.

7. In determining the selectivity between the sequence relay and the ordinary induction-type relays on the system for an out-of-step condition, it must be remembered that the induction-type relays will not operate at a time corresponding to the maximum out-of-step current, but will operate at a slower time corresponding to the effective current, which is approximately 70% of the maximum out-of-step current.

8. In calibrating and maintaining the sequence relay, each individual unit must be set accurately at the current value specified. Continuity checks may be simplified by connecting the PJC No. 1 and all PJC No. 2 units in series so that single-phase current may be applied. The sequence relay should be given a complete test once a year and inspected for pick-up and continuity once a month.

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Serving Civilian Needs in the Present Emergency

By S. P. Vecker

Vice-President, Carolina Power & Light Company

From a talk before the North Carolina Institute for Electrical Inspectors, Contractors and Electricians, Raleigh, N. C., July 14.

WE are at war and the foremost job in America today is to WIN THE WAR. It will be a long and hard war, entailing much hardship and many heartaches and requiring all types of sacrifices in order to win a complete victory and everlasting peace.

The electrical industry's problem, in common with all other industries, is that of making the best possible use of what we have. Today we must live and work by the following policy: wear it out; use it up; make it do; do without. We must adjust the essential service we furnish to the new conditions of Curtailment, Conservation, and Conversion.

This triple "C" should be our war-time watchword. CURTAILMENT on the basis of "business not as usual" —CONSERVATION on the basis of encouraging "two blades of grass to grow where one grew before"—CONVERSION on the basis of salvaging from "scrap" materials needed to win the "scrap."

Despite the suddenness of the shift from peace-time activities to war-time efforts the electrical industry has proven its mettle in a manner that should be gratifying to all of us who have had a part in the development of the industry. No matter how remote, no matter how large the military establishment, shipyard, processing plant or armament factory, the privately-managed electrical industry has been ready with ample power to meet each and every need of the Nation's gigantic production program.

It has taken real team work between utilities, equipment manufacturers, distributors, contractors, inspectors, and other factors within our industry to handle this *big job* in a *big way*. It is a record which is only possible in a land of free business enterprise. It is a tribute to the American way of doing business.

My Company is actuated with two prime motives. It recognizes that its first duty is that of all-out help toward winning the war—war comes first in everything; next it recognizes that its second duty is that of continuing to serve the needs of its civilian customers during the emergency. I have felt that morale to the fighting forces was just as important as ammunition and guns. I have felt that morale to those on the home front is more essential than any other factor with the exception of health.

Health and morale both for the winning of this war and for the preservation of our Country are the home front's indomitable essentials. Health and morale are dependent in a large measure on electric light and other electrical services that are a part of the American way of life. The day to day living in the homes, the preparation of meals, the preservation of foods, the washing and ironing of clothes, the listening to radios, the evening's studying, sewing, and reading will go on—must go on if a strong, vigorous home front is to be sustained. It behooves us, therefore, to think in terms of civilian needs and the manner in which they may be best served during this emergency.

Electrical inspectors are an integral part of the electrical utility industry. They are well qualified by years of training and experience to administer the National Code of Wiring and Safety. I wish to commend them for the high standards that they have upheld in the past and to urge them to continue in the future to bar slip-shod wiring methods and to prevent the use of unsafe materials.

Today's restrictions and limitations on construction, modernization and the use of electrical equipment and supplies place upon inspectors the added responsibility for protecting and extending the life of all materials now in use. The War Production Board, as well as other Government agencies, is constantly appealing to us to conserve all critical materials. We are being continually reminded that nothing of utile value should be purposely or unintentionally wasted since the replacement of such materials would handicap our war production program; hence, everyone using war materials must do his part in saving them.

Electrical inspectors by rechecking the cut-outs and the fuses in the old buildings can prevent needless and unnecessary interruptions of service, and so reduce and remove those hazards which have existed in the past. While only a small percentage of fires may be attributed to defective fusing, it can with certainty be said that the critical materials which have to be replaced due to such fires are a drain on our limited resources and retard the progress of our war efforts.

The development of procedures that will give the public continued high standards of workmanship and service with conservation of vital copper, rubber and steel—the discarding of old precepts—the flexibility of attitude toward the new plastic materials—possibly in some cases Code changes themselves—all this we of the electric utility industry can serenely and safely depend to leave to your ability and ingenuity.

You effectively render a war service by encouraging good lighting in the plants of war production, in the offices of those who are rendering a valuable civilian service, and in the homes where the spirits must be kept at a high level. Adequate lighting means eye-sight protection and that results in increased output, reduced wastage, and more accurate workmanship. And, too, good lighting becomes an important factor in safety—in the prevention of accidents. It likewise plays a vital part in the control of sabotage and crime, both of which have an important bearing on the morale of the people as well as in the production of vital war materials.

Another war-time need among the civilian forces in which inspectors can render a valuable assistance is in the control of essential lighting during blackout periods. Civilians have already shown their eagerness to make sacrifices in the winning of this war. The help which you can offer by suggesting the proper use of blackout materials would be a

(*Continued on page* 320)

Progress Report of American Research Committee on Grounding

DURING the past year the activities of the American Research Committee on Grounding have been continued through investigations by the Technical Subcommittee. Although the work has been impeded by the urgency of the war effort, all cases referred to the committee have been investigated.

Inspections have been made at 17 locations, of which 16 were on Long Island and one was in Pennsylvania. These are summarized in the accompanying table.

Progress has been made in the laboratory tests on the effect of current on water pipes, being conducted at New York University under the sponsorship of the American Water Works Association.

Field Investigations

Inspections were made on Cases 85 to 101 inclusive. As in the past an investigation was made in each case where an unsatisfactory water condition was reported. Wherever practicable, investigations were also conducted at other locations in the immediate vicinity for purposes of comparison. Notes on some of these investigations are given below.

Cases 87 to 90

The situation in an area supplied by a particular water district was brought to the attention of the committee by an official of a Department of Health on Long Island. In Case 87 blue water stained white laundry and a silicon bronze water storage tank failed from corrosion. Stomach or intestinal disturbances resulted from drinking water which had stood in the pipes for some time.

Altogether, four locations in this water district were inspected. All of these had unusually long water service pipes. Three which experienced blue water had copper tubing for interior piping. Two of these had 1¼ inch and 2 inch copper services and one had a 4 inch cast iron service Case 88 which did not experience blue water had yellow brass interior piping and a 1 inch copper service pipe. With unbalanced loads connected to the electric services in the basements, the locations experiencing blue water had between 2 per cent and 39 per cent, and the location without blue water, 23 per cent of the unbalanced load current on the water service.

The water in this district is supplied from deep wells and is not treated. Samples were collected from the three cases which had blue water and the analyses showed the water to have almost identical characteristics except as to copper content.

Case 91

This case of blue water was at a pump house over one of the deep wells supplying a water district on Long Island. Twenty feet of 1 inch copper tubing carried water from the discharge line from this well to a lavatory in the pump house. There was no current on this tubing under any condition of load. The water showed a slight blue color and a blue stain was found in the white lavatory.

Case 94

This case also on Long Island was at a residence with copper tubing for both service and interior piping. When rust was found in the hot water a galvanized iron hot water tank was replaced with a copper tank. Subsequently the presence of blue water prompted the owner to replace the copper tank with one made of Monel metal. This, however, did not stop the blue water. The committee was shown a toothbrush on which the bristles had turned green as a result of the water. At this house also an aluminum teakettle was so severely corroded that it was eaten through at several points and an analysis of the sediment on the inside of the teakettle showed the presence of copper With an unbalanced load of about 12 amperes there were 3 amperes (25 per cent) on the water service pipe and 1 ampere on the interior piping.

Case 95

During the inspection of Case 94 reference was made to a house in the same vicinity where no troubles were experienced. The committee found the service and interior piping in this residence was galvanized iron. The hot water storage tank was galvanized iron supplied from a small coal stove. Current measurements showed 40 per cent of the load current on the water service pipe on the street side of the ground wire and 60 per cent on the house side of the ground wire, with no current returning on the neutral conductor. It was found later that this was an open circuit in the neutral conductor of the customer's underground service cable.

Cases 96 to 101

These cases included several homes in a new development started about three years ago, all of which had copper services fed from cast iron mains and copper tubing for interior piping. Of the six locations visited, one had experienced both pipe leaks and failure of hot water storage tank, two had experienced pipe leaks, two had experienced tank failures and one had no trouble from corrosion, although the presence of corrosion products on the outside of the pipes had indicated to the owner that trouble should be expected soon. All tank leaks inspected occurred in welded seams. The three pipe failures occurred in piping above the first floor ceiling associated with upstairs bathrooms. In one case the hole in the ceiling was still open, and inspection showed that the failure was a pinhole which had been repaired by soldering. Current measurements with a test load plugged in a receptacle in the bathroom showed no current in the pipe that had failed. In another group of eight of the older houses in this development, which were not investigated, most of the storage tanks had been replaced.

All of the houses in this development had been built by the same concern and were similar in electric service, and in heating and water supply piping arrangements. With unbalanced loads on the electric service the current on the water service was between 12 per cent and 58 per cent of the unbalanced load. The current on the interior piping was between 2 per cent and 18 per cent.

Cases 71, 73, 74, 75

These cases, discussed in the report for last year, involved four residences where blue water was being experienced and where a special transformer arrangement was installed in order to eliminate all alternating current from the services and piping of two of the residences. Water analyses have been conducted

from time to time on samples from each of the four houses and so far about eight samples have been analyzed from each building, covering a period from September, 1940, to February, 1942. Although current had been eliminated from the two residences for a period of 16 months the copper content, which varied considerably from time to time in all of the houses, showed no consistent differences in the analyses of samples obtained from the homes without current as compared with samples from the homes with current on the piping. Variations in amount of usage of water may account for some of the differences in copper content.

Pipe Tests

The previous report* of activities dated August 15, 1941, mentions that the American Water Works Association has sponsored a program of pipe tests to be conducted at New York University. These tests have now been set up but have not progressed to a point where the results are indicative. Members of the Subcommittee have been cooperating with the personnel of New York University in setting up the circuits for putting a measured amount of current on some of the pipes and in the technique to be used in operating the polarograph.

The water drip test also referred to in the previous report has been discontinued as it came to be felt that no conclusive evidence would be obtained by this test.

*EEI Bulletin, Nov., 1941, Page 462.

Future Work

Although the conduct of the work of the Technical Subcommittee has been hampered by change of personnel and pressure of other work resulting from war activities, it appears at present that the committee will be able to continue to function if conditions do not become more restrictive. It is hoped to investigate all cases of unsatisfactory water conditions which are brought to the committee's attention. The committee will also continue to keep in close touch with the water pipe test being conducted at New York University.

Appendix A—Summary of Investigations July 1, 1941 to July 1, 1942

Case No.	Location	Complaint	Neutral Ground	Percentage of Unbalanced Load Current on Pipes: Water Service A	Water Service B	Gas Service	Direct Current	Type of Wiring	Water Piping Material: Main Pipe	Main Joints	Service	House	Hot Water Tank	Apparent Source of Trouble	Notes
85	Long Island, N.Y.	Rust in water from hot water storage tank	Water Pipe	47	45	-	Slight	Armored Cable	Cast Iron	Universal	Copper	Copper	Galv. Iron	Defective tank	Tank Replaced
86	Pennsylvania	Green stains	None	0	0	0	None	Knob and Tube	Cast Iron	Lead	Copper	Copper and Lead	Galv. Iron	Aggressive water	Telephone ground blamed but customer satisfied to let it alone
87	Long Island, N.Y.	Corrosion of copper tank, blue stains on wash, sickness from drinking the water	Water Pipe	23	2	7	None	Armored Cable	Cast Iron	Universal	Copper	Red Brass	(See Note)	Aggressive water	Silicon bronze tank failed from corrosion - replaced with Monel tank
88	Long Island, N.Y.	None	Water Pipe	23	0	-	-	Armored Cable	Cast Iron	Universal	Copper	Yellow Brass	Copper	No trouble	Inspected with Case 87
89	Long Island, N.Y.	Blue water	Water Pipe	2	0	-	-	Armored Cable	Cast Iron	Universal	Copper	Copper	Galv. Iron	Aggressive water	Inspected with Case 87
90	Long Island, N.Y.	Blue water	Water Pipe	29	8	12	-	Armored Cable	Cast Iron	Universal	Cast Iron	Copper	Galv. Iron	Aggressive water	Inspected with Case 87
91	Long Island, N.Y.	Blue water	Main	0	0	0	None	-	Cast Iron	-	-	Copper	None	Aggressive water	Pump house at deep well 20 ft. of copper tubing to Lavatory
92	Long Island, N.Y.	Blue water	Water Pipe	22	3	-	-	Armored Cable	Cast Iron	Lead	Copper	Copper	Copper	Aggressive water	Water partially aerated in elevated tank
93	Long Island, N.Y.	Blue water stained wash	Water Pipe	16	21	21	-	Armored Cable	Cast Iron	Lead	Copper	Copper	Copper	Aggressive water	
94	Long Island, N.Y.	Blue water stained brush bristles and corroded aluminum kettle	Water Pipe	25	9	8	-	Armored Cable	Cast Iron	Lead	Copper	Copper	(See Note)	Aggressive water	Galvanized iron tank replaced with copper on account of rust; copper tank replaced with Monel on account of blue water
95	Long Island, N.Y.	None	Water Pipe	40	60	60	-	Armored Cable	Cast Iron	Lead	Galv. Iron	Galv. Iron	Galv. Iron	No trouble	Inspected with Case 94
96	Long Island, N.Y.	Corrosion of copper pipe	Water Pipe	52	14	0	Slight	Armored Cable	Cast Iron	Lead	Copper	Copper	Copper	Moderately aggressive water	
97	Long Island, N.Y.	Corrosion of copper pipe & tank	Water Pipe	58	10	0	Slight	Armored Cable	Cast Iron	Lead	Copper	Copper	Silicon Bronze	Moderately aggressive water	
98	Long Island, N.Y.	Corrosion of copper pipe	Water Pipe	24	18	13	None	Armored Cable	Cast Iron	Lead	Copper	Copper	Silicon Bronze	Moderately aggressive water	Cases 96 to 101 in new Development. Tank failures occurred at welded seams
99	Long Island, N.Y.	Corrosion of copper tank	Water Pipe	19	2	7	-	Armored Cable	Cast Iron	Lead	Copper	Copper	Silicon Bronze	Moderately aggressive water	
100	Long Island, N.Y.	Corrosion of copper tank	Water pipe	12	6	14	-	Armored Cable	Cast Iron	Lead	Copper	Copper	Silicon Bronze	Moderately aggressive water	
101	Long Island, N.Y.	Corrosion of copper pipe	Water Pipe	21	11	0	-	Armored Cable	Cast Iron	Lead	Copper	Copper	Silicon Bronze	Moderately aggressive water	

Water Service - A - Street Side of Grounding Connection
B - House Side of Grounding Connection

Where several consecutive cases were in the same water district, the case numbers are bracketed.

Personnel of E. E. I. Committees for 1942-1943

APPOINTMENTS to EEI Committees for the administrative year 1942-1943 have been made by President Kellogg with the exception of some of the Accounting and Commercial Committees, whose membership will be announced in a later issue of the BULLETIN.

The Committees which now have practically complete personnel are shown under the following general headings of Engineering, General, Accounting Executive and General Commercial.

Engineering: Accident Prevention Committee; Electrical Equipment Committee; Meter and Service Committee; Prime Movers Committee; Transmission and Distribution Committee.

General: Insurance Committee; Membership Committee; Prize Awards Committee; Rate Research Committee; Statistical Committee.

Accounting: Accounting Executive Committee. Personnel of the Customers' Relations, Commercial Accounting and Collections Committee; Depreciation Committee; General Accounting Committee; Plant Accounting and Records Committee; Purchasing, Stores and Transportation Committee, to be announced.

General Commercial: General Commercial Committee. Personnel of the Appliance Maintenance Committee; Electric Water Heating Committee; Farm Utilization Committee; Home Service Committee; Industrial Power and Heating Committee; Lighting Committee; Planning Committee; and Wiring Committee to be announced.

The personnel of the Operating Committee is listed on the inside of the back cover of the BULLETIN.

ENGINEERING COMMITTEES

ACCIDENT PREVENTION COMMITTEE

Chairman, GEORGE S. DIEHL, Pennsylvania Water & Power Co., Baltimore, Md.

Vice-Chairman, D. C. STEWART, Buffalo Niagara & Eastern Power Corp., Buffalo, N. Y.

Secretary, A. B. CAMPBELL, Edison Electric Institute, New York, N. Y.

H. P. ALLEN, Rockland Light & Power Co., Boston, Mass.

E. E. BECK, Idaho Power Co., Boise, Idaho.

C. B. BOULET, Wisconsin Public Service Co., Milwaukee, Wis.

F. W. BROCKHOFF, Union Electric Co. of Missouri, St. Louis, Mo.

H. J. BURTON, Consumers Power Co., Jackson, Mich.

F. H. DAVIES, The Detroit Edison Co., Detroit, Mich.

RUDOLF DUELAND, Ebasco Services Inc., New York, N. Y.

B. K. DUNSHEE, Pacific Gas and Electric Co., San Francisco, Cal.

R. C. GEPPERT, Nebraska Power Co., Omaha, Neb.

ROY M. GODWIN, Philadelphia Electric Co., Philadelphia, Pa.

E. J. KREH, Duquesne Light Co., Pittsburgh, Pa.

DON T. LACEY, Central Illinois Public Service Co., Springfield, Ill.

WILLS MACLACHLAN, 50 Oakwood Avenue, Toronto, Can.

C. N. RAKESTRAW, The Cleveland Electric Illuminating Co., Cleveland, Ohio.

ALBERT A. RALL, Kansas City Power & Light Co., Kansas City, Mo.

W. T. ROGERS, Ebasco Services Inc., New York, N. Y.

W. R. SMITH, Public Service Electric & Gas Co., Newark, N. J.

H. O. SPRINKLE, Monongahela West Penn Public Service Co., Fairmont, W. Va.

H. F. WEBB, West Penn Power Co., Pittsburgh, Pa.

ELECTRICAL EQUIPMENT COMMITTEE

Chairman, R. T. HENRY, Buffalo Niagara & Eastern Power Corp., Buffalo, N. Y.

Secretary, H. E. KENT, Edison Electric Institute, New York, N. Y.

L. BIRCKHEAD, Consolidated Gas Electric Light & Power Co., Baltimore, Md.

F. S. BROWN, Duquesne Light Co., Pittsburgh, Pa.

R. N. CONWELL, Public Service Electric & Gas Co., Newark, N. J.

R. P. CRIPPEN, Ebasco Services Incorporated, New York, N. Y.

S. M. DEAN, The Detroit Edison Co., Detroit, Mich.

H. E. DEARDORFF, The Dayton Power & Light Co., Dayton, Ohio.

A. G. DEWARS, Northern States Power Co., Minneapolis, Minn.

HENRY A. DRYAR, Philadelphia Electric Co., Philadelphia, Pa.

H. W. EALES, Public Utility Engineering & Service Corp., Chicago, Ill.

E. S. FIELDS, The Cincinnati Gas & Electric Co., Cincinnati, Ohio.

H. S. FITCH, West Penn Power Co., Pittsburgh, Pa.

E. S. FITZ, Virginia Electric & Power Co., Richmond, Va.

J. H. FOOTE, The Commonwealth & Southern Corp., Jackson, Mich.

LESTER R. GAMBLE, The Washington Water Power Co., Spokane, Wash.

W. E. GUNDLACH, Wisconsin Electric Power Co., Milwaukee, Wis.

E. A. HESTER, Duquesne Light Co., Pittsburgh, Pa.

C. T. HUGHES, The Connecticut Light & Power Co., Waterbury, Conn.

J. COLEMAN JONES, Florida Power & Light Co., Miami, Fla.

E. J. KARSTEN, The United Light & Power Service Co., Davenport, Iowa.

H. J. KLUMB, Rochester Gas & Electric Corp., Rochester, N. Y.

F. A. LANE, American Gas & Electric Service Corp., New York, N. Y.

S. J. LISBERGER, Pacific Gas & Electric Co., San Francisco, Cal.

C. W. MAYOTT, The Connecticut Valley Power Exchange, Hartford, Conn.

CARL D. PRICE, The Columbus & Southern Ohio Electric Co., Columbus, Ohio.

G. E. QUINAN, Puget Sound Power & Light Co., Seattle, Wash.

H. B. ROBINSON, Carolina Power & Light Co., Raleigh, N. C.

H. J. SCHOLZ, The Commonwealth & Southern Corp., Birmingham, Ala.

E. B. SHEW, Philadelphia Electric Co., Philadelphia, Pa.

A. E. SILVER, Ebasco Services Inc., New York, N. Y.
L. M. SMITH, Alabama Power Co., Birmingham, Ala.
E. H. SNYDER, Public Service Elec. & Gas Co., Newark, N. J.
PHILIP SPORN, American Gas & Electric Service Corp., New York, N. Y.
NICHOLAS STAHL, Pennsylvania Power & Light Co., Allentown, Pa.
STANLEY STOKES, Union Electric Co. of Missouri, St. Louis, Mo.
B. VAN NESS JR., Pennsylvania Water & Power Co., Baltimore, Md.
R. W. WILBRAHAM, United Engineers & Constructors Inc., Philadelphia, Pa.
H. B. WOOD, Stone & Webster Engineering Corp., Boston, Mass.

METER AND SERVICE COMMITTEE

Chairman, H. A. HOWERY, Kansas City Power & Light Co., Kansas City, Mo.
H. A. BROWN, Rochester Gas & Electric Corp., Rochester, N. Y.
F. E. DAVIS, The Commonwealth & Southern Corp., Jackson, Mich.
EDGAR L. HUGHES, Pacific Gas & Electric Co., San Francisco, Cal.
E. E. KLINE, The Cincinnati Gas & Electric Co., Cincinnati, Ohio.
WALTER G. KNICKERBOCKER, The Detroit Edison Co., Detroit, Mich.
E. A. LEFEVER, Buffalo Niagara & Eastern Power Corp., Buffalo, N. Y.
J. A. MORRIS, American Gas & Electric Service Corp., New York, N. Y.
T. C. PITZER, West Penn Power Co., Pittsburgh, Pa.
L. D. PRICE, Public Service Electric & Gas Co., Newark, N. J.
J. N. SCHWARTZ, The Columbus & Southern Ohio Electric Co., Columbus, Ohio.
B. Z. SEGALL, New Orleans Public Service Inc., New Orleans, La.
H. F. SPREEN, Texas Electric Service Co., Fort Worth, Texas.
W. G. STEINBRIGHT, Philadelphia Electric Co., Philadelphia, Pa.
H. L. THOMSON, The Hartford Electric Light Co., Hartford, Conn.
W. L. WADSWORTH, Northern States Power Co., Minneapolis, Minn.
C. F. WHITEMAN, The Cleveland Electric Illuminating Co., Cleveland, Ohio.

PRIME MOVERS COMMITTEE

Chairman, J. A. KEETH, Kansas City Power & Light Co., Kansas City, Mo.
W. H. ALDRICH, The Cleveland Electric Illuminating Co., Cleveland, Ohio.
T. B. ALLARDICE, American Gas & Electric Service Corp., New York, N. Y.
J. R. BAKER, Pennsylvania Water & Power Co., Baltimore, Md.
C. C. BALTZLY, Philadelphia Electric Co., Philadelphia, Pa.
H. N. BOETCHER, Consolidated Gas, Electric Light & Power Co., Baltimore, Md.
F. S. CLARK, Stone & Webster Engineering Corp., Boston, Mass.
C. W. E. CLARKE, United Engineers & Constructors, Inc., Philadelphia, Pa.
SABIN CROCKER, The Detroit Edison Co., Detroit, Mich.
E. R. CROFTS, Rochester Gas & Electric Corp., Rochester, N. Y.
H. M. CUSHING, Buffalo Niagara Electric Corp., Buffalo, N. Y.
G. C. DANIELS, The Commonwealth & Southern Corp., Jackson, Mich.
F. L. DORNBROOK, Wisconsin Electric Power Co., Milwaukee, Wis.
DWIGHT DOUGLASS, The Hartford Electric Light Co., Hartford, Conn.
J. M. DRABELLE, Iowa Electric Light & Power Co., Cedar Rapids, Iowa.
W. V. DRAKE, Monongahela West Penn Public Service Co., Fairmont, W. Va.
W. C. DRUMMOND, Public Utility Engineering & Service Corp., Chicago, Ill.
J. N. EWART, Buffalo Niagara Electric Corp., Buffalo, N. Y.
F. P. FAIRCHILD, Public Service Electric & Gas Co., Newark, N. J.
C. Z. GILLIVAN, The Columbus & Southern Ohio Electric Co., Columbus, Ohio.
FRANK HENRY, Rochester Gas & Electric Corp., Rochester, N. Y.
G. D. HETTRICK, Montaup Electric Co., Fall River, Mass.
H. G. HEIBLER, Houston Lighting & Power Co., Houston, Texas.
E. L. HOPPING, Philadelphia Electric Co., Philadelphia, Pa.
A. T. HUTCHINS, The Commonwealth & Southern Corp., Birmingham, Ala.
A. H. KRAUSS, Ebasco Services Inc., New York, N. Y.
E. H. KRIEG, American Gas & Electric Service Corp, New York, N. Y.
W. R. LAMOTTE, Public Service Electric & Gas Co., Newark, N. J.
J. W. MACKENZIE, Consumers Power Co., Jackson, Mich.
H. C. MILLER, Public Service Testing Laboratory, Maplewood, N. J.
E. H. MITSCH, The Cincinnati Gas & Electric Co., Cincinnati, Ohio.
J. F. MUIR, American Water Works & Electric Co., Inc., New York, N. Y.
A. R. PARKER, Columbia Engineering Corp., Cincinnati, Ohio.
R. C. Powell, Pacific Gas and Electric Co., San Francisco, Cal.
T. E. PURCELL, Duquesne Light Co., Pittsburgh, Pa.
G. C. SEARS, Puget Sound Power & Light Co., Seattle, Wash.
G. W. SMITH, San Antonio Public Service Co., San Antonio, Texas.
M. F. STACK, Ebasco Services Inc., New York, N. Y.
D. W. STEWART, New Orleans Public Service Inc., New Orleans, La.
E. H. THROCKMORTON, The United Light & Power Service Co., Davenport, Iowa.
ROBERT M. VAN DUZER, JR., The Detroit Edison Co., Detroit, Mich.
C. C. WELCHEL, Buffalo Niagara Electric Corp., Buffalo, N. Y.
G. V. WILLIAMSON, Union Electric Co. of Missouri, St. Louis, Mo.
C. C. WILLIS, Oklahoma Gas & Electric Co., Oklahoma City, Okla.

TRANSMISSION AND DISTRIBUTON COMMITTEE

Chairman, E. V. SAYLES, The Commonwealth & Southern Corp., Jackson, Mich.
Secretary, A. B. CAMPBELL, Edison Electric Institute, New York, N. Y.
JOHN BANKUS, Portland General Electric Co., Portland, Ore.
C. E. BATHE, Oklahoma Gas & Electric Co., Oklahoma City, Okla.
G. W. BEAN, Texas Electric Service Co., Fort Worth, Texas.
A. BODICKY, Union Electric Co. of Missouri, St. Louis, Mo.
A. S. BROOKES, Public Service Electric & Gas Co., Newark, N. J.
R. A. BROWN, The Columbus & Southern Ohio Electric Co., Columbus, Ohio.
E. S. BUNDY, Buffalo Niagara Electric Corp., Buffalo, N. Y.
D. M. BUNN, Northern States Power Co., Minneapolis, Minn.
P. J. CARLIN, Florida Power & Light Co., Miami, Fla.
GILBERT COOLEY, Long Island Lighting Co., Roslyn, L. I., N. Y.
C. C. CORNELIUS, Kansas City Power & Light Co., Kansas City, Mo.
R. R. COWLES, Pacific Gas & Electric Co., San Francisco, Cal.
M. T. CRAWFORD, Puget Sound Power & Light Co., Seattle, Wash.

W. R. Doar, Carolina Power & Light Co., Raleigh, N. C.
Roy L. Dodd, Wisconsin Electric Power Co., Milwaukee, Wis.
H. A. Enos, American Gas & Electric Service Corp., New York, N. Y.
F. H. Ferguson, Puget Sound Power & Light Co., Bremerton, Wash.
G. H. Fiedler, Rochester Gas & Electric Corp., Rochester, N. Y.
L. R. Gaty, Philadelphia Electric Co., Philadelphia, Pa.
W. E. Gundlach, Wisconsin Electric Power Co., Milwaukee, Wis.
Edwin Hansson, Pennsylvania Water & Power Co., Baltimore, Md.
T. G. Hieronymus, Kansas City Power & Light Co., Kansas City, Mo.
H. W. Keller, Columbia Engineering Corp., Cincinnati, Ohio.
F. A. Kendig, The Dayton Power & Light Co., Dayton, Ohio.
John A. Koontz, Pacific Gas and Electric Co., San Francisco, Cal.
J. P. Lewis, The Connecticut Power Co., Stamford, Conn.
H. E. Long, The Connecticut Power Co., New London, Conn.
G. B. McCabe, The Detroit Edison Co., Detroit, Mich.
W. McLean, Consolidated Gas Electric Light & Power Co., Baltimore, Md.
C. B. McManus, Georgia Power Co., Atlanta, Ga.
J. S. Maloy, West Penn Power Co., Pittsburgh, Pa.
C. W. Minard, Nebraska Power Co., Omaha, Neb.
R. C. Morris, Union Electric Co. of Missouri, St. Louis, Mo.
R. E. Morse, American Gas & Electric Service Corp., New York, N. Y.
E. F. Neuzel, The Cincinnati Gas & Electric Co., Cincinnati, Ohio.
L. L. Newman, New Orleans Public Service Inc., New Orleans, La.
C. T. Nicholson, Buffalo Niagara & Eastern Power Corp., Buffalo, N. Y.
W. F. Nimmo, Virginia Electric & Power Co., Norfolk, Va.
E. W. Oesterreich, Duquesne Light Co., Pittsburgh, Pa.
F. W. Packer, Pennsylvania Power & Light Co., Allentown, Pa.
J. J. Pokorny, The Cleveland Electric Illuminating Co., Cleveland, Ohio.
G. M. Pollard, Buffalo Niagara Electric Corp., Buffalo, N. Y.
B. C. Russell, Idaho Power Co., Boise, Idaho.
Frank Sanford, The Cincinnati Gas & Electric Co., Cincinnati, Ohio.
H. P. Seelye, The Detroit Edison Co., Detroit, Mich.
A. E. Silver, Ebasco Services Inc., New York, N. Y.
C. T. Sinclair, Duquesne Light Co., Pittsburgh, Pa.
Nicholas Stahl, Pennsylvania Power & Light Co., Allentown, Pa.
P. B. Stewart, The Cincinnati Gas & Electric Co., Cincinnati, Ohio.
Howard E. Stites, Central Illinois Public Service Co., Springfield, Ill.
R. O. Sutherland, The United Light & Power Service Co., Davenport, Iowa.
G. S. VanAntwerp, Philadelphia Electric Co., Philadelphia, Pa.
J. S. Ware, Public Service Electric & Gas Co., Newark, N. J.
L. P. Works, Wisconsin Public Service Corp., Green Bay, Wis.

GENERAL COMMITTEES

INSURANCE COMMITTEE

Chairman, J. H. Nickell, Philadelphia Electric Co., Philadelphia, Pa.
A. R. Buckman, Public Service Electric & Gas Co., Newark, N. J.
I. M. Carpenter, Ebasco Services Inc., New York, N. Y.
F. H. Deckman, Columbia Engineering Corp., Columbus, Ohio.
Reginald Fleming, The Commonwealth & Southern Corp., New York, N. Y.
F. J. Holub, Duquesne Light Co., Pittsburgh, Pa.
E. R. Kropp, Union Electric Co. of Missouri, St. Louis, Mo.
Wills Maclachlan, 50 Oakwood Avenue, Toronto, Can.
John L. MacLeod, The Detroit Edison Co., Detroit, Mich.
J. G. Reese, Consolidated Gas Electric Light & Power Co., Baltimore, Md.
A. W. Reid, American Gas & Electric Service Corp., New York, N. Y.

PRIZE AWARDS COMMITTEE

Chairman, P. S. Young, Public Service Electric & Gas Co., Newark, N. J.
D. C. Barnes, Engineers Public Service Co., Inc., New York, N. Y.
C. W. Kellogg, Edison Electric Institute, New York, N. Y.

MEMBERSHIP COMMITTEE

Chairman, Edward Reynolds, Columbia Gas & Electric Corp., New York, N. Y.
W. J. Hagenah, Public Utility Engineering & Service Corp., Chicago, Ill.
Justin R. Whiting, The Commonwealth & Southern Corp., New York, N. Y.

RATE RESEARCH COMMITTEE

Chairman, F. A. Newton, The Commonwealth & Southern Corp., New York, N. Y.
H. H. Agee, Public Service Electric & Gas Co., Newark, N. J.
S. W. Andrews, American Gas & Electric Service Corp., New York, N. Y.
B. B. Beckett, Pacific Gas & Electric Co., San Francisco, Cal.
Ira L. Craig, Philadelphia Electric Co., Philadelphia, Pa.
R. D. Cutler, The Hartford Electric Light Co., Hartford, Conn.
E. D. Dreyfus, West Penn Power Co., Pittsburgh, Pa.
C. G. Eichelberger, The Cincinnati Gas & Electric Co., Cincinnati, Ohio.
C. L. Follmer, Consolidated Gas Electric Light & Power Co., Baltimore, Md.
Lester W. Frank, Western Massachusetts Companies, Springfield, Mass.
Donald A. Henry, Stone & Webster Service Corp., New York, N. Y.
J. T. Kimball, Niagara Hudson Power Corp., Buffalo, N. Y.
L. R. Lefferson, Ebasco Services Inc., New York, N. Y.
A. V. S. Lindsley, The Connecticut Light & Power Co., Waterbury, Conn.
C. E. Neil, The North American Co., New York, N. Y.
H. H. Plank, The United Gas Improvement Co., Philadelphia, Pa.
Harry A. Snow, The Detroit Edison Co., Detroit, Mich.
E. N. Strait, Public Utility Engineering & Service Corp., Chicago, Ill.
Edward Vennard, Middle West Service Co., Chicago, Ill.

STATISTICAL COMMITTEE

Chairman, W. G. Bourne, Jr., The Commonwealth & Southern Corp., New York, N. Y.
Dewey G. Baker, Nebraska Power Co., Omaha, Neb.
John Dockendoff, Wisconsin Electric Power Co., Milwaukee, Wis.

P. J. FALLON, Middle West Service Co., Chicago, Ill.
C. D. HAMLIN, Buffalo Niagara Electric Corp., Buffalo, N. Y.
ALAN W. HASTINGS, Engineers Public Service Co. Inc., New York, N. Y.
RUDOLPH JENNY, Pacific Gas and Electric Co., San Francisco, Cal.
C. R. LANDRIGAN, The Detroit Edison Co., Detroit, Mich.
W. N. LEWIS, Ebasco Services Inc., New York, N. Y.
LYLE MCDONALD, Public Service Electric & Gas Co., Newark, N. J.
WINSOR MARTIN, Public Utility Engineering & Service Corp., Chicago, Ill.
M. G. MILLER, West Penn Power Co., Pittsburgh, Pa.
W. T. NEEL, Philadelphia Electric Co., Philadelphia, Pa.
J. B. REID, Columbia Engineering Corp., New York, N. Y.
BERTON STOUT, Indianapolis Power & Light Co., Indianapolis, Ind.
C. L. WALLING, American Gas & Electric Service Corp., New York, N. Y.

Guest Member

T. H. BUCKLEY, Twin State Gas & Electric Co., Manchester, N. H.

ACCOUNTING COMMITTEE

(Personnel of other Accounting Committees will be announced in a later issue of the Bulletin)

ACCOUNTING EXECUTIVE COMMITTEE

Chairman, F. B. FLAHIVE, Columbia Gas & Electric Corp., New York, N. Y.
H. D. ANDERSON, American Gas & Electric Service Corp., New York, N. Y.
J. H. BISSELL, Stone & Webster Service Corp., Boston, Mass.
G. H. BOURNE, The Commonwealth & Southern Corp., New York, N. Y.
G. F. BRENNER, The Cincinnati Gas & Electric Co., Cincinnati, Ohio.
G. J. BRETT, Niagara Hudson Power Corp., New York, N. Y.
E. L. CASSIDY, Indianapolis Power & Light Co., Indianapolis, Ind.
A. S. CORSON, The United Gas Improvement Co., Philadelphia, Pa.
H. R. FLANEGAN, Philadelphia Electric Co., Philadelphia, Pa.
H. L. GRUEHN, Consolidated Gas Electric Light & Power Co., Baltimore, Md.
C. T. HARMON, Duquesne Light Co., Pittsburgh, Pa.
FRANKLYN HEYDECKE, Public Service Electric & Gas Co., Newark, N. J.
DONALD S. KENNEDY, Oklahoma Gas & Electric Co., Oklahoma City, Okla.
C. E. KOHLHEPP, Wisconsin Public Service Corp., Milwaukee, Wis.
J. M. KRAMARSIK, The Connecticut Light & Power Co., Hartford, Conn.
J. H. LOBBAN, The Detroit Edison Co., Detroit, Mich.
W. P. MCARDLE, Ebasco Services, Inc., New York, N. Y.
A. G. MITCHELL, Philadelphia Electric Co., Philadelphia, Pa.
C. E. PACKMAN, Middle West Service Co., Chicago, Ill.
H. H. SCAFF, Ebasco Services Inc., New York, N. Y.
A. H. SCHETTLER, Union Electric Co. of Missouri, St. Louis, Mo.
S. M. SMALLPAGE, New Orleans Public Service Inc., New Orleans, La.
R. H. SMITH, The Cleveland Electric Illuminating Co., Cleveland, Ohio.
B. C. TAYLOR, The Dayton Power & Light Co., Dayton, Ohio.
JOHN B. THURSTON, The North American Co., New York, N. Y.
R. B. TULPIN, Central Illinois Public Service Co., Springfield, Ill.
P. R. WILLIAMS, Virginia Electric & Power Co., Richmond, Va.

GENERAL COMMERCIAL COMMITTEE

(Personnel of other Commercial Committees will be announced in a later issue of the Buiietin)

GENERAL COMMERCIAL COMMITTEE

Chairman, EDWIN VENNARD, Middle West Service Co., Chicago, Ill.
A. A. BROWN, Oklahoma Gas & Electric Co., Oklahoma City, Okla.
F. A. COFFIN, Wisconsin Electric Power Co., Milwaukee, Wis.
C. A. COLLIER, Georgia Power Co., Atlanta, Ga.
A. C. CRANDALL, Indianapolis Power & Light Co., Indianapolis, Ind.
R. D. CUTLER, The Hartford Electric Light Co., Hartford, Conn.
D. M. DEBARD, Stone & Webster Service Corp., New York, N. Y.
H. E. DEXTER, Central Hudson Gas & Electric Corp., Poughkeepsie, N. Y.
R. E. FISHER, Pacific Gas and Electric Co., San Francisco, Cal.
E. F. KELLY, Central Illinois Public Service Co., Springfield, Ill.
C. H. LEATHAM, Monongahela West Penn Public Service Co., Fairmont, W. Va.
A. D. MCLAY, The Detroit Edison Co., Detroit, Mich.
F. MCQUILLIN, West Penn Power Co., Pittsburgh, Pa.
C. E. MICHEL, Union Electric Co. of Missouri, St. Louis, Mo.
G. E. MILLER, The Cleveland Electric Illuminating Co., Cleveland, Ohio.
GEORGE OUSLER, Duquesne Light Co., Pittsburgh, Pa.
W. E. PARROTT, Ebasco Services Inc., New York, N. Y.
J. F. PORTER, JR., Kansas City Power & Light Co., Kansas City, Mo.
P. H. POWERS, West Penn Power Co., Pittsburgh, Pa.
M. R. RODGER, Middle West Service Co., Chicago, Ill.
W. H. SAMMIS, The Commonwealth & Southern Corp., New York, N. Y.
H. M. SAWYER, American Gas & Electric Service Corp., New York, N. Y.
M. E. SKINNER, Buffalo Niagara & Eastern Power Corp., Buffalo, N. Y.
FAY SMITH, Nebraska Power Co., Omaha, Neb.
MISS FERN SNIDER, Georgia Power Co., Atlanta, Ga.
H. P. J. STEINMETZ, Public Service Electric & Gas Co., Newark, N. J.
H. R. STEVENSON, The Detroit Edison Co., Detroit, Mich.
R. H. TILLMAN, Consolidated Gas Electric Light & Power Co., Baltimore, Md.
C. M. TURNER, Ebasco Services Inc., New York, N. Y.
R. P. WAGNER, New York Power & Light Corp., Albany, N. Y.
G. E. WHITWELL, Philadelphia Electric Co., Philadelphia, Pa.
H. E. YOUNG, Northern States Power Co., Minneapolis, Minn.

PERSONALS

JOHN L. O'TOOLE, vice-president in charge of public relations for the Public Service Corp. of New Jersey and its operating companies, retired on August 19, on which date he attained his seventieth year. He will continue as a director. Mr. O'Toole has been with the company since 1909.

THOMAS E. ROACH has been made vice-president and general manager of the Northwestern Electric Co., Portland, Ore.

JOHN C. PLANKINTON has been appointed assistant general manager in charge of the company's business development department. Mr. Plankinton, formerly manager of commercial and industrial sales, has been acting head of the department since October.

CLYDE V. HUSSEY has been named assistant to the President of the Arkansas Power and Light Company with headquarters in Pine Bluff. Mr. Hussey was formerly division manager of the Mississippi Power and Light Company at Jackson.

A. W. TRIMBLE, formerly assistant treasurer of the Mountain States Power Company has been elected vice-president and treasurer of that utility, to succeed B. E. LEE, who has resigned because of illness. Mr. Lee has been vice-president and treasurer since 1940. He was retained as an assistant treasurer.

ELLIS L. PHILLIPS, chairman of the board of the Long Island Lighting Company, recently received the honorary degree of doctor of laws from the Ohio Wesleyan University. Mr. Phillips received the same degree earlier this year from Florida Southern College.

ALEXANDER B. GILFILLAN has been appointed assistant to the manager of retail sales of the Philadelphia Electric Co. Mr. Gilfillan celebrated his thirty-fifth anniversary with the company last year. During his entire service with the utility he has specialized in retail sales, lighting, and small power sales work.

R. R. ROBLEY has been appointed assistant to President James H. Polhemus of the Portland General Electric Co. Mr. Robley, who for two years has been assistant to Vice-President GEORGE E. SULLIVAN, takes over many duties previously performed by CAPT FRANK M. WARREN, JR., vice-president, who entered military service. Mr Robley has been identified with Portland utility for 38 years.

A native Northwesterner and a graduate of the University of Oregon, Mr. Robley joined the Portland General Electric Co. in 1904. He had previously been a wireman on the construction of the electron plant near Seattle for the Puget Sound Power & Light Co. He occupied many positions in the operating department of the Portland company and for several years was designated superintendent of operations. In 1940 he became assistant to Vice-President Sullivan, the position he held until his present promotion.

FRED R. GROCH has been taken from the statistical department of the company and appointed as assistant to the vice-president, the position left vacant by the advancement of Mr. Robley. He was associated with Prof. F. O. McMillan of Oregon State College in a rate study for the company in 1940, on completion of which he remained in the company's statistical department. A graduate of California Institute of Technology, he was associated with electric utility companies in California prior to affiliating himself with the Portland utility.

H. M. JORDAN, recently local manager for the Alabama Power Co. at Leeds, is now manager of the recently formed Oneonta district, embracing operations in and around Oneonta, Blountsville, Warrior and Arab. Mr. Jordan has had a long and varied experience with the company since his first employment in 1920 on construction work. Prior to his transfer to the Oneonta district, he served as local manager at Parrish, Fayette and Leeds.

HARRY MCCANN has been appointed superintendent of operations for the Missoula division of the Montana Power Co., succeeding Shirley Thane, resigned. Mr. McCann joined the organization in 1928.

JOHN E. JACKSON, manager of the Lynchburg district of the Appalachian Electric Power Co., has been granted leave of absence to join the staff of the United States Office of Scientific Research and Development in Washington. G. ROBERTS NEUBAUER, assistant manager, will be in charge of the company's operations during Mr. Jackson's absence.

LLOYD T. WILLIAMS, employed in the engineering department of Southwestern Gas and Electric Company for several years, has been named acting chief engineer, filling the position of S. M. SHARP who left July 17 for active duty as a captain in the signal corps of the United States Army.

Mr. Williams, who first became associated with the company in 1924, became assistant engineer in the building of the 66 kv transmission line from Shreveport, Louisiana, to Texarkana, Ark.-Tex. He then became a member of the Shreveport engineering department.

In 1930 he left the company to accept a position with the Dallas Power & Light Company in their designing division. In 1931 he returned to Southwestern Gas and Electric Company in various capacities in the oil field and in 1938 he was made division engineer for the East Texas oil field district. In 1939 he was transferred to Texarkana as assistant to the late Andrew Patterson, who at that time was chief engineer of the company. He went to Shreveport in 1940 when the general office engineering department was moved there.

Mr. Williams was graduated from Texas A. & M. in 1925 with a B.S. degree in electrical engineering.

C. T. BAKEMAN, industrial and commercial lighting director for the Puget Sound Power and Light Company, in Seattle, for the past fifteen years, has been appointed assistant director of the Northwest sector of the Office of Civilian Defense. Mr. Bakeman will continue in his present capacity with the utility company, which has cooperated with OCD in allowing Mr. Bakeman to give as much of his time as required to the public work. He has been working with the OCD in blackout activities since the last trial blackout of the city.

E.E.I. PUBLICATIONS AND PROMOTIONAL MATERIAL

(Prices include transportation in U. S. only. Please order by number shown before title. Standing Orders may be placed for a specified number of copies of reports of various committees as issued, to be shipped to one address.)

Payable in United States Currency—Postage Stamps Not Acceptable

Accounting and Statistical

	Members	Non Members
Accounting		
Digest of Authoritative Opinions of the Definition of Original Cost (Including Appendix on "Prudent Investment") 1938	$1.50	$1.50
Proceedings 1942 Meeting of Gas and Electric Accountants	1.00	1.00
Proceedings—National Accounting Conferences		
Complete Set—6th Conference 1942	1.00	1.00
" " 5th " 1941	2.00	2.00
" " 4th " 1940	2.00	2.00
" " 3rd " 1939	2.00	2.00
" " 2nd " 1938	1.50	1.50
by Groups Yearly—		
Classification of Accounts	.50	.50
Customer's Relation	.50	.50
Depreciation	.50	.50
Plant Accounting and Records	.50	.50
Purchasing Stores & Transportation	.50	.50
General Sessions	.50	.50
Summary of Definitions Covering Depreciation and Related Terms 1939.	1.00	1.00
Statistical		
J-2—Electric Light and Power Industry in 1941 (5/42)	.30	.75
I-2—Electric Light and Power Industry in 1940 (5/41)	.30	.75
(Statistical Bulletins also available for years 1932 to 1939 inclusive) each.	.30	.75
Weekly, Monthly and Annual Statistics (Includes Annual Statistical Bulletin; Weekly Electric Power output; Monthly Electrical Research Statistics).	2.00	2.00

Engineering Committees

ACCIDENT PREVENTION—RESUSCITATION

F-10—Tree Trimming Practices (10/38)	20	.50	.60
E-12—Resuscitation Booklets (7/37)	1— 9 copies	.10 each	
	10— 99 "	.08 "	
	100—499 "	.06 "	
D-18—Your Unseen Helper (1936)	1,000	$10.	
	5,000	30.	
	10,000	50.	
	25,000	110.	
C-14—Resuscitation Charts (4/36)		.10	.10
C-12—Twelve Messages on Accident Prevention in the Electric Public Utilities (12/35)		.10	.10

ELECTRICAL EQUIPMENT COMMITTEE

F-13—Reconditioning Flood Damaged Electrical Equipment (12/38)	$ .30	$ .75
F-5—Design of Switchhouses for Generating Stations and Transmission Substation (6/38)	.40	1.00
E-1—Rectifier Wave Shape (4/37)	.40	1.00
C-10—Symbols for Metering Diagrams (12/35)	.10	.10
B-10—Electrical Energy Diversion (10/34)	.20	.50

HYDRAULIC POWER COMMITTEE

D-15—Penstocks (12/35)	1.00	2.50
A-19—Hydraulic Governors (8/33)	.20	.50

JOINT REPORTS

J-6—Wave Shape of Multi-Phase Rectifiers—Engr. Report No. 49—Joint Subcommittee on Development and Research (8/42)	.50	1.25
J-4—Low Frequency Shielding in Telephone Cables—Engineering Report No. 48—Joint Subcommittee on Development and Research (5/42).	.80	2.00
J-1—Positive Disconnection of Distribution Circuits During Faults to Ground—Engineering Report No. 47—Joint Subcommittee on Development and Research (4/42)	.60	1.50
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WAVE-SHAPE CHARACTERISTICS OF MULTI-PHASE RECTIFIERS

EEI Pub. J-6. Engineering Report No. 49. A report of the Joint Sub-committee on Development and Research, Edison Electric Institute and Bell Telephone, 28 pages. Price 50c to EEI members and their employees; $1.25 to non-members in the U. S. A.; $1.35 to foreign countries.

THE wave-shape characteristics of a-c power systems supplying mercury-arc rectifiers were investigated by the Joint Subcommittee on Development and Research several years ago. The results of this study were included in Engineering Report No. 22[1] (Wave Shape Characteristics of Wave Circuits Supplying Rectifiers) which discussed the basic factors involved and described measures then available for reducing the inductive influence of such systems.

More recently, the unprecedented demand for d-c power in the electro-chemical and electro-metallurgical industries has resulted in an increasing number of very large mercury-arc rectifier installations. When the first of these large plants were placed in operation, it became evident that coordinative measures would be necessary if widespread distortion of the supply-system wave shape and resulting noise increases on neighboring telephone circuits were to be avoided. In view of the size of these rectifier installations and the complexity of the supply systems involved, the application of frequency selective devices of the types previously used with smaller rectifiers, as described in the above Engineering Report, seemed impracticable.

Consideration was then given to other coordinative measures including the possibility of increasing the number of rectifier phases. Engineering Report No. 22, while recognizing that the wave-shape characteristics of a rectifier might be improved by this means, pointed out that it had been found impracticable commercially to provide more than 12 phases in a single rectifier unit. However, because of practical limitations on the size of single rectifier units, the large installations under consideration were made up of a number of independent 6-phase or 12-phase rectifiers operated in parallel on both their a-c and d-c sides. Laboratory studies, subsequently confirmed by field experience, demonstrated that, by properly adjusting the phase relations between the voltages applied to the individual rectifier units, arrangements of this character could be operated on a multi-phase basis.

The present report presents the results of a study, by Project Committee 1, of the effectiveness of phase multiplication from an inductive coordination standpoint. It describes the operation of phase-shifting devices commonly employed and demonstrates the application of these devices in providing for the multi-phase operation of various groups of 6-phase and 12-phase rectifiers. The theoretical discussion is supported by test data taken in a number of field situations in which phase multiplication has been employed as a means of controlling wave-shape distortion and telephone circuit noise. Data indicating the extent to which unbalances may impair the effectiveness of multi-phase connections are also included.

[1] *Wave Shape of 30- and 60-Phase Rectifier Groups*, O. K. Marti and T. A. Taylor, A. I. E. E. Trans., vol. 59, pp. 218-224 (April 1940).

Serving Civilian Needs

(*Continued from page* 310)

means of bolstering that spirit of home front morale.

The electrical contracting profession is likewise facing a most critical period. Its peace-time functions cannot be carried on in the face of drastic restrictions and curtailment in the manufacture, distribution, and use of many materials. Such circumstances have influenced many contractors to seek work in defense plants and in the construction of war camps—in fact many members of the contracting group have left the smaller towns and communities for the entire emergency period. In such instances the home makers and business men face added difficulties, for the trained electrician may no longer be there to serve the needs which are acute and which will become more so as the conflict continues.

True, new construction is stymied and the use of copper and other critical materials has been drastically curtailed, but services which are being used by over thirty million homes, farms, stores, offices, and factories in this country must be kept flowing if morale is to be kept at a level essential to victory. Electrical equipment must be kept in operation in order to meet the actual needs of the people on the home front. Your services may now prevent serious appliance and apparatus break-downs—and aid most effectively in deferring the use of critical material so vitally needed in the manufacture of fighting equipment. The home front is turning to you and will in a large measure depend upon your repair services in keeping this equipment in operation.

I think it is only natural that as Americans we should look forward to the time when victory is won and peace prevails. Our people are financing freedom with their earnings and savings—buying Victory Bonds and War Stamps. Each day brings us closer to the war's end—closer to the time when replacement equipment will be available. Then the market will be flooded with buyers possessed of money in denominations never heretofore witnessed—they will create a sellers paradise. You will be placed in a most strategic position—one which will enable you to supply this big fertile market, for those customers in whom you have built confidence through repair service for the period of the duration will express themselves in terms of profitable purchases from you.

The manufacturers are likewise looking to the future. As expressed recently by one of the leaders in the electrical manufacturing field, "Even with electric appliance manufacture now stopped until after the war, we are all busy with research, invention and design. We are studying with utmost criticism the product of today, to make tomorrow's better in point of efficiency, utility, and style. We are working to find new uses for electricity in the home. More money than ever before is being spent on forward-looking developments. It is our fond hope that the post-war product will provide a new impetus to the uses of electricity in the home."

In the past my Company has rendered its customers a modern, streamlined service. It is possible that now we no longer can give them, in all instances, this same type of service. Possibly we shall not be able to come as quickly in response to their service calls. Possibly we may not even be able to supply their needs.

We must ask our customers that they be tolerant of us. They must understand that because of war needs, their own needs, if not entirely sacrificed, may have to take a secondary position. Why?

First, the need for conserving critical material. War Production Board Order P-46 restricts the extension of service to only those individuals and concerns whose requirements are contributing directly to the war effort—whether in the construction of armaments, the production of foods, or the building of public morale.

Second, the need for curtailing transportation. Office of Defense Transportation Order No. 6 grants priority rights to a limited use of tires and gasoline and vehicle replacement for certain phases of our operations but excludes such priority rights for other phases of our operations.

Third, the need for converting manpower. Already many of my fellow employees are serving in the armed forces—thus creating a problem of maintaining an adequate staff to carry on normal operations.

In spite of all this, my company does pledge to its customers its best efforts. Should we fall short of expectations, it will not be because of lack of that same earnest desire to serve them and serve them well that has motivated us and spurred us on in times past.

Let us make sure that we of the electrical industry keep abreast of progress. Let us prove tolerant and open-minded toward new developments whether they be of a substitute nature or for permanent adoption. Let us exercise our ingenuity in using the things that have been given us in place of things that have been taken away. Let it never be said that our industry failed to serve our Nation's needs or civilian needs because of its inability to break with traditions or to accept the new.

Let us all remember that our first job is to win the war. Let us never forget that we on the home front have the responsibility for the safety and the success of the men on the battle front.

And when the war is won, and with it the kind of peace that carries the democratic way of life — then, once again, shall it be the privilege of the utility industry to pioneer in bringing new and greater conveniences, comforts, and economies to the homes and businesses of America; and then once again shall the American Way of Living go forward with renewed strides to bring greater peace, happiness, and prosperity to all peoples.

CONVENTIONS AND MEETINGS

SEPTEMBER

11	Pennsylvania Electric Association, Bellevue-Stratford Hotel, Philadelphia, Pa.
17-18	International Association of Electrical Inspectors, Northwestern Section, Portland Hotel, Portland, Ore.
21-22	Illuminating Engineering Society, Jefferson Hotel, St. Louis, Mo.
21-23	International Association of Electrical Inspectors, Southwestern Section, Fresno, Calif.
24-25	Indiana Electric Association, Indianapolis, Ind.

OCTOBER

5-6	American Gas Association, La Salle Hotel, Chicago, Ill.
5-7	International Association of Electrical Inspectors, Western Section, Book-Cadillac Hotel, Detroit, Mich.
12-14	American Society of Mechanical Engineers, Hotel Sagamore, Rochester, N. Y.
12-14	International Association of Electrical Inspectors, Eastern Section, Taft Hotel, New Haven, Conn.
14-16	American Institute of Electrical Engineers, Pittsburgh, Pa.
19-21	International Association of Electrical Inspectors, Southern Section, John Marshall Hotel, Richmond, Va.
27-29	National Safety Council Congress, Chicago, Ill.
26-30	National Electrical Manufacturers Association, Waldorf-Astoria Hotel, New York, N. Y.

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